Wisconsin Citizen Lake Monitoring Training Manual

(Secchi Disc Procedures)

3rd Edition

Written by
Carolyn Rumery Betz
and Patricia J. Howard

Revised by
Sandy Wickman and Laura Herman

Front cover photos courtesy of Laura Herman, Robert Korth and the Wisconsin Department of Natural Resources photo archives.

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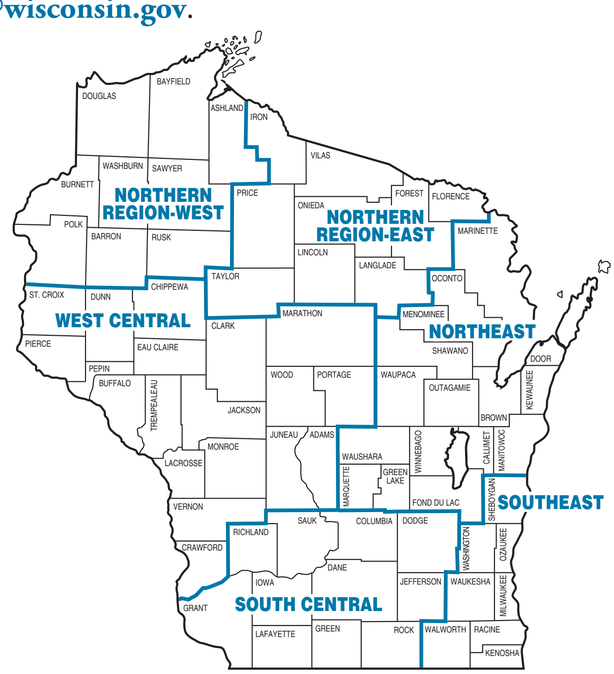
NOTES

Need Answers to Your Questions?

When questions arise please contact the appropriate Citizen Lake Monitoring Network coordinators listed below. You may also be able to find answers to your questions on the Wisconsin Department of Natural Resources website at **http://dnr.wi.gov/lakes/CLMN** by choosing the link for "Frequently Asked Questions" on the left side of the page.

If you are interested in becoming a citizen lake monitoring volunteer, or have questions about training, refresher courses, or other monitoring opportunities, please contact Laura Herman, Citizen Lake Monitoring Network Educator, at (715) 365-8998 (Rhinelander) or (715) 346-3989 (Stevens Point), or by email **Laura.Herman@uwsp.edu**.

For questions about the database, reporting data, awards, or annual reports please contact Jennifer Filbert at (608) 264-8533 or toll free at (888) 947-3282, or by email **Jennifer.Filbert@wisconsin.gov**.



For questions about equipment, sampling procedures, or interpreting your water quality data, please contact your regional coordinator. You can visit **http://dnr.wi.gov/lakes/CLMN** for a current listing of Citizen Lake Monitoring Network coordinators or call the service center listed below and ask for your citizen monitoring network coordinator.

Location	**Phone Number**
Northern Region-West	(715) 635-2101
Northern Region-East	(715) 365-8900
Northeast Region	(920) 662-5100
West Central Region	(715) 839-3700
Southeast Region	(414) 263-8500
South Central Region	(608) 275-3266

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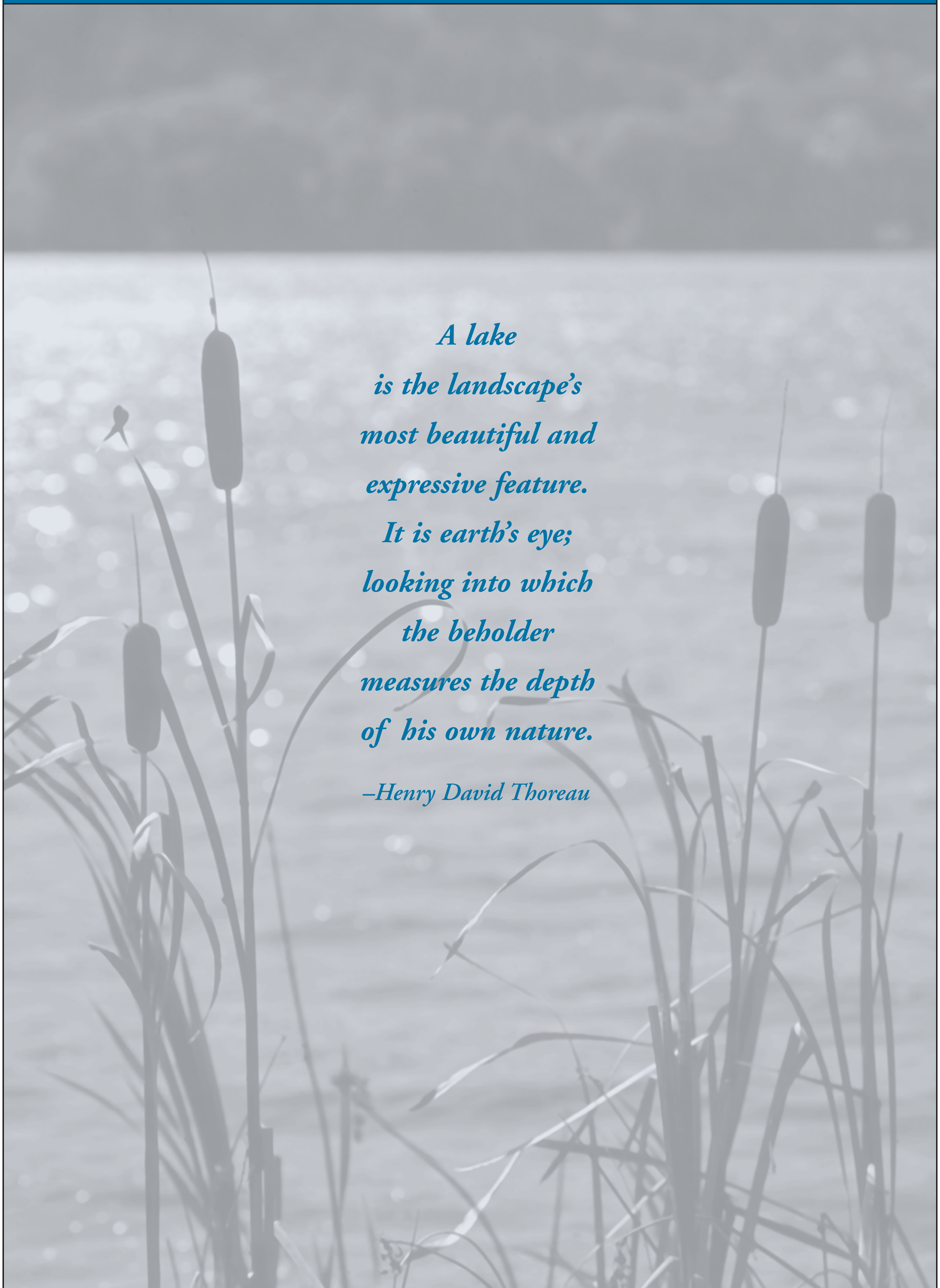


A lake
is the landscape's
most beautiful and
expressive feature.
It is earth's eye;
looking into which
the beholder
measures the depth
of his own nature.

–Henry David Thoreau

Introduction

THANK YOU for joining the Citizen Lake Monitoring Network (CLMN or Network). You are one of over a thousand citizen volunteers currently monitoring Wisconsin's lakes. Over one million acres of Wisconsin is covered by water. Wisconsin's 15,000 lakes contribute significantly to the economy of individual communities and the state. In addition, these lakes offer diverse recreational opportunities and provide important habitat for fish, waterfowl, and other wildlife. The volunteer monitoring network provides an opportunity for citizens to take an active role in monitoring and helping to maintain water quality. Through this volunteer network, you can learn about your lake and help the Wisconsin Lakes Partnership gain a better understanding of our state's lakes. More importantly, you can share your knowledge and the information you gather with your **lake association** and other lake residents.

The partnering of concerned citizens and the Wisconsin Department of Natural Resources (Wisconsin DNR) was initiated in 1986. In the Network's first year, volunteers throughout the state monitored 129 lakes. Since then, the Network has grown to include over 1,200 volunteers monitoring more than 900 lakes statewide! Some volunteers monitor more than one lake and some larger lakes are monitored at more than one location. Many volunteers share monitoring responsibilities with a friend or a group of friends.

Since 1986, the partnership has grown to include volunteers, the Wisconsin DNR, University of Wisconsin – Extension (UWEX), and Wisconsin Association of Lakes (WAL). CLMN offers volunteers the opportunity to collect many types of data. The types of data you collect will depend on what your concerns and interests are, as well as the amount of time you wish to spend monitoring. **Secchi disc** monitoring is the backbone of CLMN and is the most common type of monitoring. Secchi volunteers collect water clarity information on their lakes throughout the open water season. After collecting Secchi data for one or more years, some volunteers choose to get involved in other types of monitoring. Secchi volunteers may be asked by their Lakes Coordinator to collect chemistry data on their lake. Chemistry volunteers collect **phosphorus** and **chlorophyll** samples

A full glossary of highlighted terms is provided on page 46 of this manual.

LAKE ASSOCIATION *• A voluntary organization with a membership generally comprised of those who own land on or near a lake. The goals of lake associations usually include maintaining, protecting, and improving the quality of a lake, its fisheries, and its watershed.*

SECCHI DISC *• A 20-cm (8-inch) diameter disc painted white and black in alternating quadrants. It is used to measure light transparency in lakes.*

PHOSPHORUS *• The major nutrient influencing plant and algal growth in more than 80% of Wisconsin lakes. Soluble reactive phosphorus refers to the amount of phosphorus in solution that is available to plants and algae. Total phosphorus refers to the amount of phosphorus in solution (reactive) and in particulate forms (non-reactive).*

CHLOROPHYLL *• Green pigment present in all plant life and necessary for photosynthesis. The amount of chlorophyll present in lake water depends on the amount of algae and is used as a common indicator of water quality.*

four times a year *in addition to* collecting Secchi data. This more extensive volunteer monitoring allows Wisconsin DNR lake managers to assess the nutrient enrichment state for their lakes. In addition, some volunteers also collect temperature and **dissolved oxygen** (DO) data for their lakes. Other types of monitoring activities include aquatic invasive species monitoring and native aquatic plant monitoring. Ideally, all volunteers will be able to find a level of involvement that suits their interests and abilities.

The partnership between the volunteer monitors and the Wisconsin DNR has resulted in an extensive volunteer monitoring database. Data collected by volunteers has been published in numerous reports and is frequently used by limnologists (scientists who study lakes) and water resource planners for a variety of purposes. In addition, volunteer data is reported to the U.S. Environmental Protection Agency (EPA) on a regular basis.

DISSOLVED OXYGEN • *A measure of the amount of oxygen gas dissolved in water and available for use by microorganisms and fish. Dissolved oxygen is produced by aquatic plants and algae as part of photosynthesis.*

LAKE CLASSIFICATION • *A way of placing lakes into categories with management strategies best suited to the types of lakes found in each category. For example, lakes can be classified to apply varying shoreland development standards. They can be grouped based on hydrology, average depth, surface area, shoreline configuration, as well as, sensitivity to pollutants and recreational use.*

What is Expected of Me?

What we need most from you is your time and your keen powers of observation! As a Secchi volunteer, you will determine how the water clarity of your lake compares to similar lakes statewide and watch for long-term changes. The Network will provide all of the equipment that you will need to collect your data. You may be asked to participate in refresher sessions. These sessions provide an opportunity to meet other volunteers and to ask Wisconsin DNR staff questions about monitoring and lake issues as well as ensuring that all volunteers are following CLMN monitoring protocols.

There are three things that may influence your enjoyment when participating as a citizen volunteer: your overall health, the type of boat you use, and whether or not you have a sampling partner. While the sampling duties are not too physically demanding, you should be in good overall health. A fishing-type boat or pontoon boat is ideal for sampling work and will be safer and more comfortable than a canoe. A sampling partner will make your job safer, easier, and faster as one person can record data while the other collects samples.

Children of a culture born in a water-rich environment, we have never really learned how important water is to us. We understand it, but we do not respect it.

–William Ashworth

LINDA POHLOD

HOW IS CLMN DATA USED?

All citizen volunteers receive an annual data summary report for their lake as well as periodic statewide reports. Most volunteers share this information with other lake residents who are interested in learning more about lake water quality. Lake groups, UWEX agents, and county land conservation offices use CLMN data to support water quality projects such as shoreland restoration, **lake classification**, shoreland zoning, and nutrient diversion projects as well as to study lakes and aquatic invasive species. All lake data is available to the public on the Wisconsin DNR web site **http://dnr.wi.gov/lakes/CLMN/reportsanddata**.

Local and state offices use CLMN data to answer questions they receive regarding macrophyte and water levels, property purchases, and algal blooms. Professionals and lay people use CLMN data in newsletter articles and in presentations to lake associations.

Fish biologists and lake managers use volunteer data to

- support general lake management decisions,
- support lake planning and protection grants,
- craft aquatic invasive species management decisions,
- determine lake health,
- look at winterkill or summer anoxic conditions,
- supplement statewide long-term trend data to analyze trends and issues and climate change, and
- establish "baseline" data to look at water quality changes and trends through time.

Wisconsin DNR researchers use CLMN data to correlate water clarity and water quality with loon use of a waterbody. Some waterbodies that historically were used by loons are no longer being used – researchers will look at CLMN data to help determine why. Researchers will also use CLMN data to further investigate climate change.

Volunteer data is provided to other organizations, the state legislature, and federal, tribal, and local agencies that in turn may use this data to help determine funding for invasive species grants and programs. Every two years, lake data are included in Wisconsin's Biennial Water Quality Report to Congress.

Volunteer data is also used by World Monitoring Day™, an international education and outreach program that builds public awareness and involvement in protecting water resources around the world by engaging citizens to conduct basic monitoring of their local water bodies.

Volunteer data is incorporated into the Secchi Dip-In. The Secchi Dip-In is a demonstration of the potential of volunteer monitors to gather environmentally important information on our lakes, rivers, and estuaries. The concept of the Secchi Dip-In is simple: individuals in volunteer monitoring programs take a transparency measurement on one day during the weeks surrounding Canada Day and July Fourth. Individuals monitor lakes, reservoirs, estuaries, rivers, and streams. These transparency values are used to assess the transparency of volunteer-monitored waterbodies in the United States and Canada.

WHAT IS THE REMOTE SENSING PROGRAM?

The University of Wisconsin (UW) has been successful in predicting water clarity in lakes using satellite images. Every year the Wisconsin DNR receives this satellite data. Different atmospheric conditions (e.g. cloud cover) occur in each satellite photo, so in order to predict water clarity for all the lakes in any given satellite image, the UW needs volunteer Secchi data that correspond to the lakes in each satellite photo. As a Secchi volunteer, the Network will send you the dates that satellite photos will be taken of your lake. Try to obtain Secchi readings on as many of these satellite dates as you can. Just think, on a clear satellite date, your Secchi reading may translate into hundreds of other readings; almost as if you're monitoring hundreds of lakes at one time! Find out more about remote sensing at http://dnr.wi.gov/lakes/CLMN/remotesensing/.

Sample Schedule

A typical year of volunteer monitoring may look something like this:

February

All current volunteers will receive an annual report summarizing last year's lake data. Volunteers with access to the Internet can print out their own lake summary report from the CLMN website. Volunteers who do not have access to the Internet will receive a paper copy of last year's lake summary report in the mail. At this time, some volunteers will also receive awards for their service, including awards for monitoring milestones such as years of service or number of secchi readings taken.

March

Spring monitoring supplies will be mailed out to volunteers. Volunteers with Internet access can print off their own data sheets and find their remote sensing schedule. The annual Wisconsin Lakes Convention is held in March or April.

April

Volunteers begin monitoring as soon as the ice is off the lake. Secchi volunteers continue taking readings every 10 to 14 days throughout the open water season.

May

New volunteers are trained.

June

Invasive Species Awareness Month.

July

Secchi readings are taken in conjunction with satellite dates. Satellite path and satellite schedule can be found at http://dnr.wi.gov/lakes/CLMN/remotesensing/.

Great American Dip In (http://dnr.wi.gov/lakes/CLMN/dipin).

August

Secchi readings are taken in conjunction with satellite dates.

September

Secchi readings are taken in conjunction with satellite dates.

October

Volunteers wrap up Secchi monitoring for the season.

November

Volunteers ensure that all data has been submitted to Wisconsin DNR staff in the Madison office. If data has been entered on the Internet you do not need to submit a paper copy. If data has been called in, volunteers should submit a paper copy so that observations can be entered into the database.

December

Volunteers send any comments or needs (such as repair needs) to their regional coordinator.

THE CITIZEN LAKE MONITORING NETWORK PARTNERSHIP

Volunteer citizen lake monitoring is a team effort with many players including citizen volunteers, Wisconsin DNR, UWEX and WAL.

The citizen volunteer is the most important player in the lake monitoring network.

You know your lake on a day-to-day basis. You know the best spots to fish and what birds visit or nest on the lake. You know when the lake freezes over, when the ice goes out, and you know your neighbors and friends who love and use the lake. You volunteer to participate because of your genuine concern for the lake and your desire to learn more about it. Collecting water quality data is a step in the right direction to gaining a better understanding of your lake.

We depend on volunteers to share the information that they learn about their lakes with their Lake Association, Lake District, or other residents on the lake. You have the best access to your neighbors. Many volunteers share their lake status report every year at annual meetings. Your lake summary report, graphs, and narrative will help you to prepare this report. Your CLMN regional coordinator or Wisconsin DNR lakes coordinator are available to assist you if you need help providing this information to your lake group.

Another member of the partnership is the Wisconsin DNR CLMN Regional Coordinator and local staff.

Local staff is located in one of the Wisconsin DNR regional offices around the state. As a citizen volunteer, you may already know them or have worked with them in the past. If you have any questions about your lake and your monitoring duties, these are the first people you should contact to help answer your questions.

Wisconsin DNR CLMN staff located in Madison.

Staff help maintain and analyze the volunteer data, keep track of awards, produce reports, and logistically keep the Network running smoothly. Volunteers can enter the data they collect online at **http://dnr.wi.gov/lakes/clmn**. Volunteers without Internet access can phone in their data using the "Secchi line" at (888) 947-3282.

By the conclusion of the sampling season you will receive an email or postcard reminding you that reports about your lake are available online at the Wisconsin DNR website at **http://dnr.wi.gov/lakes/clmn**. The reports summarize previous years' data collected on your lake. These reports include text, graphs, and pictures that help you understand how the data you collected in the past year relates to your lake. The reports summarize previous years' data collected on your lake. In the future, web pages will be available that summarize the data by region and from a statewide perspective. This will enable you to compare the data you collected with data collected from other lakes in Wisconsin similar to yours.

The University of Wisconsin – Extension lakes staff in Stevens Point.

The CLMN Statewide Coordinator is housed at UWEX. UWEX lakes staff ensure that trainers (Wisconsin DNR regional staff, outside agency trainers, and volunteer trainers) follow the Network's protocols when volunteers are trained. This ensures statewide consistency in data collected. UWEX staff write monitoring protocols; help to oversee the Quality Assurance/Quality Control portion of the Network; and order, build, and repair equipment for the Network.

All citizen volunteers will receive *Lake Tides*, a quarterly newsletter published by the Wisconsin Lakes Partnership. The newsletter can also be viewed online at **http://www.uwsp.edu/cnr/uwexlakes/laketides/**. Each issue of Lake Tides has several pages dedicated to topics of interest to CLMN volunteers. This news covers current developments and maintains the volunteers' connection to one another.

WAL provides a free *E-lake* letter. This publication has information on key lake issues, legislative activity affecting lakes, and upcoming lake events. The *E-lake* is delivered right to your email inbox! Occasional action alerts keep you informed of policy developments that may affect our lakes. To receive your free *E-lake* go to **http://www.wisconsinlakes.org**.

THE CLMN LAKE MONITORING NETWORK HAS TEN PRIMARY GOALS

1. **Quality and Accessible Data.**
Following collection protocols will enable you to collect quality data on your lake. Recording your Secchi disc readings and water chemistry data carefully, regularly and according to procedures, will provide valuable information about your lake. When you report your data to the Network, it is readily available through a database on the Internet. The Wisconsin DNR relies on your data. Without your help, very few lakes would be monitored.

2. **Document Water Quality Changes Over Time.**
The Network's aim is to document water quality changes over time by summarizing the data that you collect and sharing that data with other volunteers and organizations. This is particularly important for those lakes where little or no data exists. You will be collecting baseline data that cannot be captured again in the future; and that will be used for decades to come. You will be able to compare your lake to hundreds of others using the statewide Summary Report. After several years of monitoring, your regional coordinator can work with you or your Lake Association to determine whether or not your lake should receive more intensive monitoring or management attention.

3. **Educated and Informed Citizen Monitors.**
The Network's goal is to help you learn more about basic **limnology**. By collecting, summarizing, and reviewing your data, you will increase your understanding of your lake's overall water quality and will be able to share this information with your Lake Association or other lake residents. The information you collect can be used to help make decisions about your lake (e.g., use restrictions, **watershed** management decisions, aquatic plant management, etc.).

4. **Greater Number and Frequency of Lakes Monitored.**
The Wisconsin DNR relies on citizen volunteers for most of its data. In a given year, Wisconsin DNR staff can only get out to a limited number of lakes, and often only get to these lakes once a year or once every five years. Your help allows many more lakes to be monitored on a much more frequent basis.

5. **Enhanced Participation in Statewide Network of Volunteer Monitors.**
The Network is exploring the possibility of forming a statewide network with other Wisconsin monitoring efforts, such as, LoonWatch, Water Action Volunteer Stream Monitoring, and others.

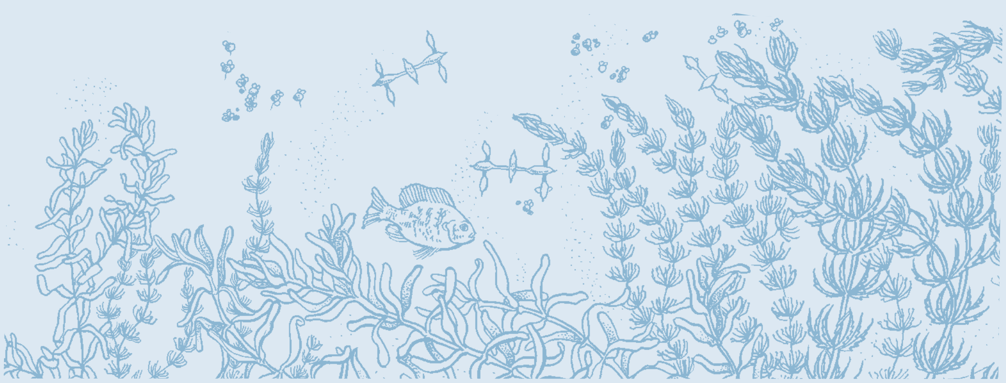
6. **Quality Support.**
Support staff, located in Madison, are available to help you with database or data reporting questions and questions regarding awards. Each region of the state has a regional coordinator who is in charge of training volunteers and answering questions about equipment and sampling procedures and can answer questions about annual reports.

7. **Reduced Administrative Overhead (state, community, and citizen).**
Volunteer help reduces the Wisconsin DNR's operating costs and helps streamline workflow. By having volunteers sample lakes that need to be monitored, the Wisconsin DNR saves time and money involved in having staff travel to those lakes in order to collect the data. Those staff can in turn concentrate their efforts on other lakes. It is a win-win situation. Additionally, it is the Network's goal to keep monitoring and data reporting as simple and efficient as possible for the citizen volunteer.

8. **Engage Others in Support of the Network.**
The Network is supported through a partnership, not just the Wisconsin DNR. The University of Wisconsin-Extension, Wisconsin Association of Lakes, and private entities are engaged in providing support and services to the statewide network. Volunteers often serve as mentors or trainers for other volunteers.

9. **Tie-in to National Lake Research and Monitoring.**
Data is often used for lake research. For example, volunteer data has been used to successfully derive water clarity data on thousands of lakes from satellite imagery. You can see the results of this effort and learn more about satellite imagery and water clarity at **http://lakesat.ssec.wisc.edu or http://dnr.wi.gov/lakes/CLMN/remotesensing**/. Volunteers are also annual participants in the "Secchi Dip-in," an international effort to monitor lakes. Visit **http://dipin.kent.edu** online for more information.

10. **Recognize and Appreciate Citizen Involvement.**
At the end of each monitoring season, the Network provides awards to volunteers who have monitored for 5, 10, 15, or 20 years, or volunteers who have taken 100 or 500 Secchi readings on their lake!



CAROL WATKINS, UW-EXTENSION, ENVIRONMENTAL RESOURCES CENTER

LIMNOLOGY • *The study of inland lakes and waters. The study of the interactions of the biological, chemical, and physical parameters of lakes and rivers.*

WATERSHED • *The area of land draining into a specific stream, river, lake or other body of water.*

What Types of Monitoring Can I Participate In?

If you have an interest in any of the following monitoring activities, please contact your regional coordinator.

Secchi

Father Pietro Angelo Secchi was an astrophysicist and the scientific advisor to the Pope in Italy. He was asked by the head of the Papal Navy to develop a way to measure transparency in the Mediterranean Sea. Secchi used white discs to measure the clarity of water in the Mediterranean in April of l865. The Secchi disc was adopted for use by limnologists as a way to measure water clarity and to set a numerical value to water quality. Secchi discs come in various sizes and colors and even the shape may be slightly different depending on use.

A Secchi depth reading is intended to give a general picture of your lake's water clarity. The sampling is easy to do and does not require sophisticated, high-maintenance equipment nor demand a background in science, chemistry, or engineering. One Secchi reading will not tell you a great deal about your lake but Secchi disc readings taken over a period of time will tell a story about your lake – is your water clarity improving, declining, or remaining the same?

Wisconsin CLMN uses a Secchi disc that is 8 inches in diameter. The Secchi disc is black and white and weighted with a stainless steel plate. CLMN protocols must be followed closely so that the data that you collect can be compared to other lakes. The Secchi disc is lowered into the water on a marked rope until it just disappears from view, that point is marked with a clothespin at the water's surface. Volunteers then lower the disc a couple of feet further into the water. They then slowly raise the disc until they can see it again. That point is also marked with a clothespin. The average of these two measurements is recorded. Doing the two measurements using the "clothespin method" allows the volunteer's eyes to acclimate to looking in the water and gives a more accurate reading. Measuring the water clarity or transparency of lakes over time provides a "pulse" on the health of these lakes, and is a crucial record for long-range planning.

Water Chemistry

After one year of water clarity monitoring, you may be eligible to participate in water chemistry monitoring. Chemistry volunteers, in addition to measuring water clarity and temperature, collect water samples for analysis for phosphorus and chlorophyll levels four times a year. Volunteer collected samples are sent to the **State Laboratory of Hygiene (SLOH)** for analysis. The information volunteers collect when monitoring both Secchi and water chemistry is used to determine the **trophic state** of the lake. Training and equipment for chemistry monitoring are provided by the Wisconsin DNR. Secchi volunteers who have participated in the Network for at least one sampling season and are interested in becoming a chemistry volunteer should contact their CLMN regional coordinator. The number of chemistry lakes that are added each year is limited due to the cost of equipment and the cost of sample analysis by SLOH. Because of budget limitations lakes are prioritized according to the need for information.

Temperature and Dissolved Oxygen

There are times when the lakes coordinator or fish biologist will ask to have volunteers collect dissolved oxygen and temperature information on a lake. This request is usually triggered by certain conditions such as oxygen depletion, the presence of aquatic invasive species, or presence of cold water fish species.

Volunteers collecting dissolved oxygen and temperature profiles usually collect the information at three-foot intervals from the surface of the lake to the bed of the lake. A van dorn water sampler is used to bring the water from the various depths up to the surface for testing. Volunteers living on deep lakes may be asked to collect a profile using five or ten foot intervals. Your collection profile will be assigned by your regional coordinator. This sample technique helps to explain the dynamics of your lake. The purpose behind collecting profile data is to show how water characteristics can change with depth. In general, volunteers collect the dissolved oxygen and temperature profile at its deepest point (the deep hole).

Dissolved oxygen information is collected using the Winkler titration method. This method is rather time consuming and demands great attention to detail but if done properly gives accurate results. If warranted, a lake group may apply for a small scale grant to purchase a dissolved oxygen meter.

Native Aquatic Plant Monitoring

Aquatic plants are a good indicator of lake health. Over time, the type of vegetation and size of plant beds may change and/or move in response to changes in water quality and human activity. Aquatic plant monitoring is tailored to your abilities, interest, and time commitment and can vary from lake to lake. Some volunteers choose to identify and map plant beds on the lake, keeping track of beds based on whether the plants are submergent, emergent, or floating.

Other volunteers wish to have a more comprehensive list of the aquatic plants that are present on their lake. They identify, collect, and press their lake's aquatic plants and map the plants' location. All plants collected by volunteers are verified by Wisconsin DNR staff and a university plant taxonomist. Familiarizing yourself as to what aquatic vegetation is present in your lake is a great way to monitor for the presence of **aquatic invasive species**.

Aquatic Invasive Species (AIS) Monitoring

Citizen volunteer monitoring protocols for all AIS listed below can be found at **http://www.uwsp.edu/cnr/uwexlakes/clmn/publications.asp**. New species may be added in the future.

Eurasian Water-milfoil (EWM) Watch

All volunteers are encouraged to monitor their lake for Eurasian water-milfoil (*Myriophyllum spicatum*). EWM is an aquatic plant that is not native to the United States and continues to populate many lakes throughout

PUBLIC PERCEPTION OF WATER QUALITY

As part of your Secchi data collection, the Network is interested in your opinion of the lake's water quality when you are sampling. Using these observations, a public opinion assessment of water clarity can be made. This information will help determine water quality standards for lakes. There is no right or wrong answer to these questions and your answer can change throughout the summer or in subsequent years. Specifically, citizen volunteers will be asked to note the algal content of the water. Is there so much algae that you want to shower after swimming? Do you not want to go swimming? In addition to the Secchi disc readings that you measure, the Network is concerned with your opinion of what constitutes good or poor water quality.

The Network predicts that the public opinion question will reveal that people living in one area of the state will have similar perceptions of what they consider to be acceptable water clarity. The Network hopes to share this information with other states in anticipation of creating a regional map of public perceptions of water clarity.

STATE LABORATORY OF HYGIENE • *The state of Wisconsin's public health and environmental laboratory.*

TROPHIC STATE • *The extent to which the process of eutrophication has occurred is reflected in a lake's trophic classification or state. The three major trophic states are oligotrophic, mesotrophic, and eutrophic.*

AQUATIC INVASIVE SPECIES (AIS) • *Refers to species of plant or animal that are not native to a particular region into which they have moved or invaded. Zebra mussels and Eurasian water-milfoil are examples of AIS. Wisconsin has a law that prohibits someone from placing a boat in the water if aquatic plants or zebra mussels are attached to the boat.*

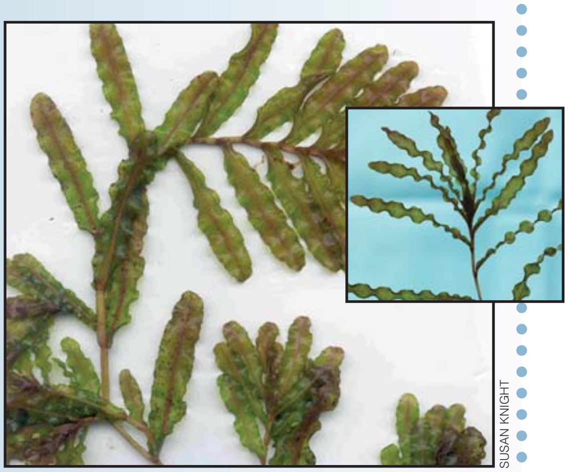
© Used with permission by University of Florida Center for Aquatic Plants (Gainesville).

DNR PHOTO

Eurasian Water-milfoil

ROBERT L. JOHNSON

Aquatic weevil feeding on Eurasian water-milfoil. (Photo provided with permission by Cornell University **www.forestryimages.org**).



SUSAN KNIGHT

Curly-leaf Pondweed

Wisconsin. This plant can dominate lake habitats and displace native species. Watching for this non-native plant is not difficult. It involves inspecting shorelines and water surfaces for plant fragments and checking plant beds throughout the lake a few times during the summer. Early identification of this non-native plant makes it easier to control. Volunteers interested in participating in the EWM watch receive a packet containing a laminated plant scan for identification, information on how to report findings, and instructions on when and where to look for the plant. Information on EWM can be found at **http://dnr.wi.gov/invasives/fact/milfoil.htm**.

Euhrychiopsis lecontei Watch

EWM is a submerged aquatic plant that is not native to the United States. Since it is not native to Wisconsin or to the United States, it has few natural predators.

Eurychiopsis lecontei, an aquatic water-milfoil weevil, is a water-milfoil specialist native to parts of the United States, including Wisconsin. This weevil feeds solely on water-milfoil with northern water-milfoil (*Myriophyllum sibiricum*) being its primary native food base. The weevils have also been found to eat EWM.

Volunteers are trained to look for the presence of the milfoil weevil on their lake. This weevil study is being conducted to obtain a better understanding of the ecology of weevil populations and what types of water-milfoil populations are susceptible to weevil damage. Early research done by the Wisconsin Cooperative Fishery Research Unit showed weevil populations are negatively affected by high water temperatures, fish predation, calcium carbonate deposits, some nutrients and chemicals, and a lack of natural shoreline. Information on the milfoil weevil can be found at **http://fwcb.cfans.umn.edu/research/milfoil/milfoilbc.html**.

Curly-leaf Pondweed Watch

In Wisconsin, curly-leaf pondweed (*Potamogeton crispus*) usually completes its life cycle by June or July. In most lakes, the over summering bud (**turion**) breaks off from the plant, falls to the bottom of the lake, and lies submerged and dormant during the late summer months. Responding to the shortening day length and cooling water temperatures, turions put out roots in late summer or early fall. The new plant continues to grow even under the ice of winter if snow depth is not great and there is enough sunlight coming through the ice.

Volunteers are asked to check plant beds on calm, clear days from ice off until mid-July. If volunteers find something that may be curly-leaf pondweed, they are asked to collect a sample and bring it to their CLMN regional coordinator for identification. Information on curly-leaf pondweed can be found at **http://dnr.wi.gov/invasives/fact/curlyleaf_pondweed.htm**.

Purple Loosestrife Watch

Another non-native species that volunteers are encouraged to watch for is purple loosestrife. Purple loosestrife (*Lythrum salicaria*) is a beautiful but aggressive plant from Europe that can displace native wetland vegetation. Because this non-native flowering plant is often confused with native wetland plants (e.g., pickerel weed and smartweed) volunteers are provided with materials to make identification easier. Once familiar with the plant, monitoring involves watching shorelines and wetlands in July, looking for the characteristic bright magenta flowers of purple loosestrife. If new infestations are found, a report is sent to the DNR identifying its location.

Volunteers may be asked to control small, isolated infestations or new pioneering plants by cutting, pulling, or chemical treatment. Larger infestations may require large-scale chemical or biological control efforts. In these cases, volunteers may be recruited to rear and release *Galerucella spp.* beetles that feed on purple loosestrife. Reporting forms and instructions for monitoring and control are provided. Information on purple loosestrife can be found at **http://dnr.wi.gov/invasives/fact/loosestrife.htm**.

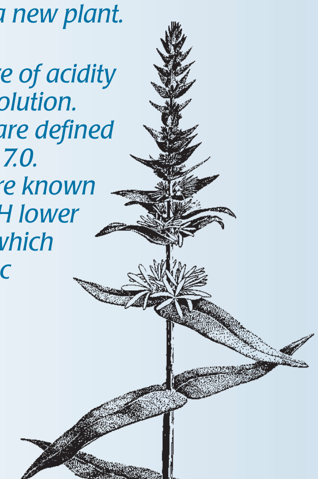
Hydrilla Watch

Hydrilla (*Hydrilla verticillata*) is a submerged aquatic plant native to Asia and northern Australia. Hydrilla is a prolific, rapidly growing plant that has very effective means of reproduction. In areas of North America where hydrilla has been introduced it has formed dense canopies that shade out native vegetation and destroy fish and wildlife habitat. The plant has a tendency to canopy out over the surface of the water which has detrimental impacts on fisheries and recreation, and creates harsh conditions for other species by raising **pH**, decreasing oxygen under the canopy mats, and increasing water temperature.

In 2007, hydrilla was discovered in a man-made pond in Marinette County, Wisconsin. It is the only known occurrence of the plant in Wisconsin. Because

TURION *• A specialized bud which consists of condensed leaves and stems. This structure is most often an "over-wintering" structure, but in the case of curly-leaf pondweed is an "over-summering" structure. When the appropriate water conditions are reached, the turion will sprout a new plant.*

pH *• The measure of acidity or alkalinity of a solution. Neutral solutions are defined as having a pH of 7.0. Solutions which are known as acidic have a pH lower than 7. Solutions which are known as basic have a pH greater than 7.*



Purple Loosestrife

DAVE BRENNER

(*D. Brenner photos provided with permission by Michigan Sea Grant* **www.miseagrant.umich.edu**).

VIC RAMEY

Hydrilla

(*Photo by Vic Ramey, University of Florida/FAS Center for Aquatic and Invasive Plants. Used with permission.*)

ZEBRA MUSSEL • *A tiny bottom-dwelling mollusk native to Europe.*

DAVE BRENNER

Zebra Mussel

BOB KORTH

Quagga Mussel

JEFF GUNDERSON

Rusty Crayfish

(*D. Brenner and Jeff Gunderson photos provided with permission by Michigan Sea Grant* **www.miseagrant.umich.edu**).

hydrilla can be easily confused with our native elodea (*Elodea canadensis* and *Elodea nuttalli*) it can be easily overlooked if not careful. We are particularly interested in recruiting volunteers who live on lakes near Marinette County in the event that hydrilla moved to other waterbodies by the movement of either wildlife or humans. For more information on hydrilla check out **http://dnr.wi.gov/invasives/fact/hydrilla.htm**.

Zebra and Quagga Mussel Watch

The zebra mussel (*Dreissena polymorpha*) is a non-native species that has been recently introduced into Wisconsin's lakes. Once in a lake, this mussel species (in Wisconsin, many mussel species go by the common name of "clam") can spread rapidly and has the potential to alter natural lake communities. The quagga mussel (*Dreissena rostriformis bugensis*) has been found in the Great Lakes, but not in any inland lakes. Both mussels have a high rate of reproduction and are able to attach themselves to almost anything including docks, boats, rocks, sticks, plants, and even other mussels. As a result, beautiful swimming areas can become a foul smelling mess of broken and discarded shells. By watching for these mussels, volunteers can help with our understanding of these organisms and hopefully slow their spread. Volunteers complete shoreline surveys and perform brief inspections of docks, boats, and other places where zebra and quagga mussels are likely to be found. Surveys are done on lakes several times during the open-water season. Volunteers may be asked to set up a substrate sampler on your lake at a designated location. The data that you collect will be sent to the Wisconsin DNR to track mussel presence. Information on zebra and quagga mussels can be found at **http://dnr.wi.gov/invasives/animals.asp**.

Rusty Crayfish Watch

Rusty crayfish (*Orconectes rusticus*) are native to streams in the Ohio River basin states of Ohio, Kentucky, Illinois, Indiana, and Tennessee. These crayfish are not native to Wisconsin and were likely introduced to Wisconsin waters by anglers who used them as live bait. Rusties eat about four times the amount of food native crayfish eat and will eat small fish, insects, fish eggs, and aquatic plants. They displace native crayfish and destroy aquatic plant beds by uprooting plants. Fewer plant beds reduce the amount of cover available to fish and can result in algal blooms. Rusty crayfish are considered messy eaters. They often only eat small pieces of what they pick, allowing the remainder to float away. If rusty crayfish are eating EWM, they can spread fragments of the plants. Training is available to CLMN volunteers to look for the presence of rusty crayfish in their lake. Information on rusty crayfish can be found at **http://www.seagrant.umn.edu/ais/rustycrayfish**.

Spiny Waterflea Watch

Spiny waterfleas (*Bythotrephes longimanus*) and fish hook waterfleas (Cercopagis sp.) are small crustaceans distantly related to shrimp. They can move long distances by floating on water currents and can actively swim to "hunt" prey. Both species of waterflea entered the Great Lakes in ship ballast water from Europe. The spiny waterflea arrived in the 1980s, followed in the 1990s by the fish hook waterflea. One or both of the species are now found in all of the Great Lakes. Spiny waterfleas have been found in some inland lakes in Wisconsin.

Both species tend to gather in masses on fishing lines and downrigger cables so anglers may be the first to discover a new infestation. For more information on spiny water flea and fish hook waterflea check out **http://dnr.wi.gov/invasives/animals.asp**.

Chinese and Banded Mystery Snail Monitoring

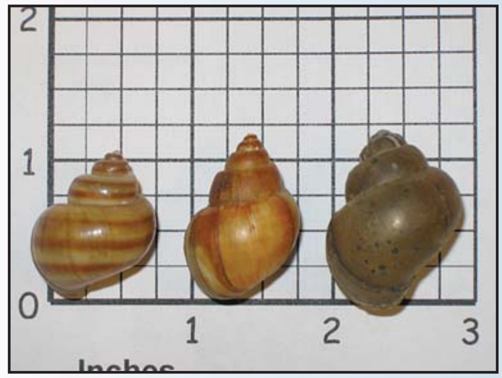
There are three species of mystery snails in Wisconsin. Only one of these species, the brown mystery snail (*Campeloma decisum*) is native to Wisconsin. The Chinese mystery snail (*Bellamya chinensis*) is native to Asia. The banded mystery snail (*Viviparus georgianus*) is native to southeastern United States. The UW Center for Limnology is assembling information on the number of lakes that these non-native snails are found on and researching the effects of these snails on the lake community. Information on Chinese mystery snails can be found at **http://www.in.gov/dnr/files/chinese_mystery_snail.pdf**.

Freshwater Jellyfish Watch

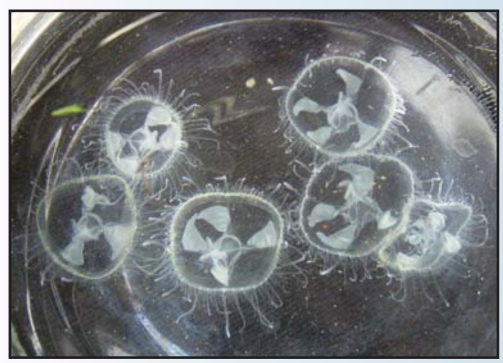
The freshwater jellyfish found in Wisconsin are one of several species of Craspedacusta native to China. Two species (*C. sowerbii* and *C. sinensis*) live in the Yangtze River. The freshwater jellyfish are not true jellyfish – they belong to the class Hydrozoa which includes the common hydra. Freshwater jellyfish were first reported in North America as early as 1884. Sightings in Wisconsin date to 1969.


DOUGLAS A. JENSEN

Spiny Waterflea


LAURA HERMAN

Banded Mystery Snail (left), Brown Mystery Snail which is native to Wisconsin (center), and Chinese Mystery Snail (right).


SHARON MILSTEAD

Freshwater Jellyfish



PHOTOS: DAN GUSTAFSON

New Zealand Mudsnail
(see page 14)

The biology of the freshwater jellyfish is complicated. The appearance of the jellyfish is described as sporadic and unpredictable. Often, jellyfish will appear in a body of water in large numbers even though they were never reported there before. The following year they may be absent and may not reappear until several years later. It is also possible for the jellyfish to appear once and never appear in that body of water again. In Wisconsin, jellyfish usually appear during dry and hot summers. More information on freshwater jellyfish can be found at **http://www.jellyfish.iup.edu**.

New Zealand Mud Snail Watch

New Zealand mud snails (*Potamopyrgus antipodarum*) are small ($^1/_8$ inch) snails that have brown or black cone shaped shells with five (usually but can have up to eight) whorls. They are native to New Zealand but have become an invasive species in Australia, Europe, and North America. In the United States they are a threat to trout streams in the western part of the country. They have been found in the Duluth Harbor, on Lake Superior, and in 2008 were discovered in Lake Michigan. New Zealand mud snails have been found in all of the Great Lakes with the exception of Lake Huron.

In their native habitat, the snails pose no problem because of a trematode parasite which sterilizes many snails, keeping the population to a manageable size. However, they have become an invasive pest species elsewhere in the world in the absence of these parasites.

Although they are small, they have the ability to reproduce rapidly and mass in high densities. Mudsnails are able to withstand desiccation, a variety of temperature regimes, and are so small that they can inadvertently be moved from one water body to another by anglers, boaters, and recreational users. More information on New Zealand mud snails can be found at **http://seagrant.wisc.edu/ais**.

Additional Opportunities: Beyond CLMN

LoonWatch

In 1978, the Sigurd Olson Environmental Institute began a loon conservation program in Wisconsin. Later a similar program in Minnesota was started. In 1988, these two loon programs were combined into one program known as LoonWatch. It is estimated that the 20,000 loons in the Upper Great Lakes States of Minnesota, Wisconsin, and Michigan comprise nearly three-quarters of the loon population outside of Alaska. Although LoonWatch is not specifically part of CLMN, we encourage volunteers to get involved in this very worthwhile program. If you are interested in volunteering to help monitor these precious birds please contact the Sigurd Olson Environmental Institute at (715) 682-1220 or via email at **loonwatch@northland.edu**. More information on this program can be found at **http://www.northland.edu/soei/loonwatch.asp**.

Secchi Trainers

CLMN is seeking trainers to train volunteers in Secchi monitoring. At present, Wisconsin DNR and UWEX staff does not have the time available to train all of the volunteers interested in Secchi monitoring. Trainers are necessary to keep up with the training demands. Secchi trainers may host Secchi training sessions for volunteers or train on a one-on-one basis. Training sessions may be co-hosted by trainers and Wisconsin DNR staff where the trainer sets up the workshop and the Wisconsin DNR staff conduct the training session. If trainers are comfortable with hosting their own workshops and teaching volunteers how to collect Secchi data, these trainers present monitoring protocols, distribute manuals and equipment to volunteers, and assist volunteers in data entry. Trainers may be asked to help host Quality Assurance/Quality Control workshops. If you are interested in becoming a Secchi trainer, contact Laura Herman, CLMN Educator at (715) 365-8998 (Rhinelander) or email at **Laura.Herman@uwsp.edu**.

Clean Boats, Clean Waters

Volunteers can be a valuable tool to lake managers in helping to stop the spread of invasive species across the state. Volunteers are trained to organize and conduct watercraft inspections at the boat landings in their communities. Trained volunteers then educate boaters on how and where invasive species are most likely to hitch a ride into water bodies. By performing boat and trailer checks, distributing informational brochures, and collecting and reporting suspect specimens, volunteers can make a difference in helping to prevent the spread of invasive species. If you are interested in participating in the Clean Boats, Clean Waters program, contact Erin Henegar at (715) 346-4978 or by email at **Erin.Henegar@uwsp.edu**. More information on this program can be found at **http://www.uwsp.edu/cnr/uwexlakes/CBCW/**.

Water Action Volunteers

Water Action Volunteer Stream Monitoring

Water Action Volunteers is a statewide program for Wisconsin citizens who want to learn about and improve the overall quality of Wisconsin's streams and rivers. This program currently offers informational materials and support for citizen stream monitoring, as well as, storm drain stenciling, river cleanups, and other action-oriented water resource protection projects. If you are interested in learning how Water Action Volunteers can help your stream or river, contact Kris Stepenuck at (608) 265-3887 or by email at **Kris.Stepenuck@ces.uwex.edu.** More information on this program can be found at **http://watermonitoring.uwex.edu/wav/**.

Wisconsin NatureMapping

This exciting wildlife survey provides fun for everyone. Observe wildlife in the field and note its location on a map. Then go to the interactive website **http://www.wisnatmap.org** and enter your observations. Anyone can view the data, and your contributions will help resource agencies with their planning and management decisions. Wisconsin NatureMapping is an outreach program that allows school children, citizens, community groups, and other city, county, and state organizations to collect wildlife-related information and share it with others. This program also provides an opportunity for students and volunteers to perform field studies that contribute to Wisconsin's various biological databases. More information on Wisconsin NatureMapping can be found at **http://www.wisnatmap.com**.

HELP STOP THE SPREAD OF INVASIVE SPECIES

Wisconsin law prohibits launching a boat or placing a trailer or boat equipment in navigable waters if it has aquatic plants or zebra mussels attached (check county regulations for additional restrictions). The main way Eurasian water-milfoil is moved between water bodies is by small fragments transported on recreational equipment. It is commonly transported by boats, trailers, bait buckets, live wells, and fishing equipment. To help prevent the spread of Eurasian water-milfoil and other invasive species, please take the following steps.

- ☑ Inspect and remove any visible mud, plants, fish or animals before transporting.
- ☑ Drain water from equipment (e.g., boat, motor, trailer, live wells, etc.) before transporting.
- ☑ Dispose of unwanted live bait in the trash.
- ☑ Ensure that all boat landings on your lake are posted with Eurasian water-milfoil signs that describe the plant and instruct boaters to remove all plant fragments from their boats and trailers before launching.
- ☑ Rinse boat and equipment with hot or high pressure water and dry for at least five days.
- ☑ Learn to easily recognize Eurasian water-milfoil. Monitor boat landings, marinas, and inlets on a regular basis for the first sign of an invasion. Report new sightings to your nearest Wisconsin DNR office.
- ☑ Work with your local lake association to develop an aquatic plant management program for your lake including contingency plans in case Eurasian water-milfoil is found in the lake.
- ☑ Help others understand the benefits of native plants and use discretion in their control.

Factors that Affect Water Clarity

Water clarity is a measure of the amount of particles in the water, or the extent to which light can travel through the water. There are many ways to express water clarity, including Secchi disc depth, turbidity, color, suspended solids, or light extinction. Chlorophyll-a, collected by water chemistry volunteers, is a measurement of the amount of **algae** that is in the water.

Water clarity is important for a number of reasons. It affects the depth to which aquatic plants can grow, dissolved oxygen content, and water temperature. Fish and loons and other wildlife depend on good water clarity to find food. Water clarity is often used as a measure of trophic status, or an indicator of ecosystem health. Water clarity is important aesthetically and can affect property values and recreational use of a water body (Tim Asplund, March 2000).

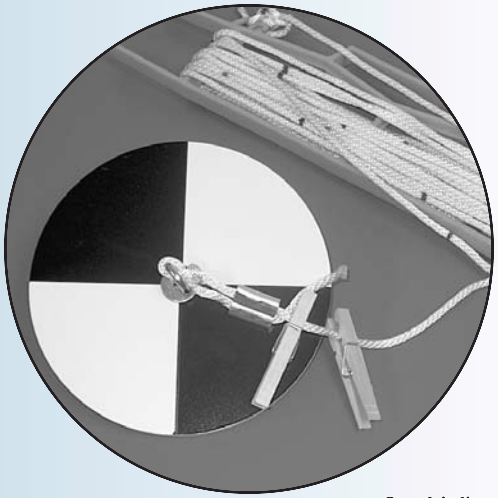
Suspended sediments, algal growth, runoff, shoreline erosion, wind mixing of the lake bottom, and tannic and humic acids from wetlands can all affect water clarity. Water clarity often fluctuates seasonally and can be affected by storms, wind, normal cycles in food webs, and rough fish such as carp, suckers, and bullheads.

Suspended Sediments

Sediment may enter the lake from a river or stream. Sediment may also come from land use activities in the **watershed** including erosion from cropland and **runoff** from barnyards, construction sites, and city streets. In a shallow lake, sediment from the lake bottom can be suspended throughout the water column during heavy winds. Additionally, certain fish species (e.g., carp) may stir up bottom sediments and make the lake appear muddy. A lake with a lot of suspended sediment will appear cloudy, muddy, or brown. As a result, the Secchi disc may disappear from view within a few feet of the water's surface.

Algae

Phytoplankton (a type of free-floating algae) is a vital part of the food chain in aquatic systems. They provide the food base for **zooplankton** (microscopic animals)



DNR PHOTO

Secchi disc.

ALGAE • *Small aquatic plants containing chlorophyll and without roots that occur as single cell or multi-celled colonies. Algae form the base of the food chain in an aquatic environment.*

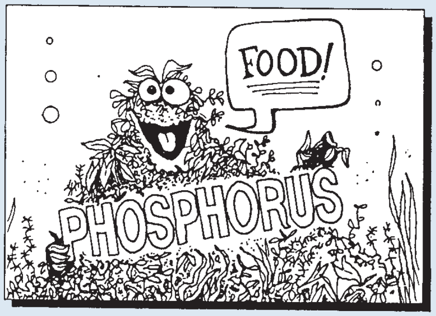
WATERSHED • *The area of land draining into a specific stream, river, lake, or other body of water.*

RUNOFF • *Water from rain, snow melt, or irrigation that flows over the ground surface and into streams or lakes.*

PHYTOPLANKTON • *Very small free-floating aquatic plants, such as one-celled algae. Their abundance, as measured by the amount of chlorophyll a in a water sample, is commonly used to classify the trophic status of a lake.*

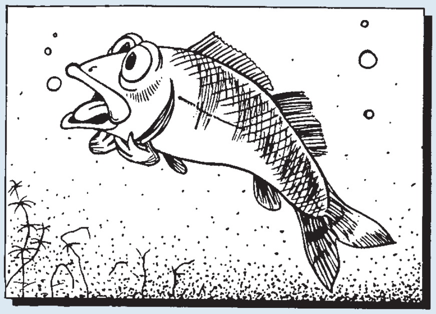
ZOOPLANKTON • *Plankton that is made up of microscopic animals, for example, protozoa, that eat algae. These suspended plankton are an important component of the lake food chain and ecosystem. For many fish and crustaceans, they are the primary source of food.*

FAMILIAR SIGNS OF RUNOFF POLLUTION

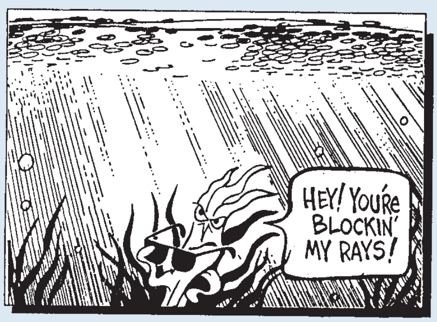


ALGAE

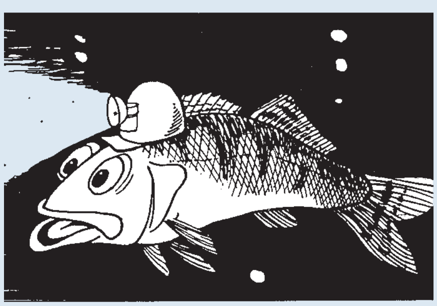
Nutrients, such as phosphorus and nitrogen, come from sediments, manure, pet wastes, improperly maintained septic systems, and misapplication of fertilizers on lawns or farm fields. Phosphorus contributes to the **eutrophication** (over-fertilization) of lakes. This leads to an increase in aquatic macrophyte and algae growth. Excess aquatic macrophytes and algae are harmful to fish and make a lake less attractive for swimming, boating, and other activities (UW Extension 2001).



When algae and aquatic weeds die they are broken down by bacteria. Bacteria consume oxygen during decomposition and make it difficult for fish and other aquatic life to survive. Excess aquatic macrophytes also contribute to winter fish kills in shallow lakes (UW Extension 2001).



Excess algae can reduce populations of bottom-rooted plants by blocking sunlight. Bottom-rooted plants provide food and habitat for fish and waterfowl (UW Extension 2001).



SEDIMENT

Sediments can cause water to become cloudy, or "turbid", making it difficult for fish to see and feed properly. Sediments can also damage fish gills and impair the feeding and breathing processes in aquatic insects (UW Extension 2001).

Sediments cloud the water and cover plant leaves, reducing sunlight penetration and inhibiting photosynthesis. Without photosynthesis, desirable plant populations are reduced, leaving fewer habitats for fish and small organisms (UW Extension 2001).

EUTROPHICATION *• The process by which lakes and streams are enriched by nutrients causing an increase in plant and algae growth. This process includes physical, chemical, and biological changes that take place after a lake receives inputs for plant nutrients (mostly nitrates and phosphates) from natural erosion and runoff from the surrounding land basin. The extent this process occurs is reflected in a lake's trophic classification. Lakes can be classified as being oligotrophic (nutrient poor), mesotrophic (moderately productive), or eutrophic (very productive and fertile).*

NITROGEN *• One of the major nutrients required for the growth of aquatic plants and algae. Various forms of nitrogen can be found in water: organic nitrogen, most of which eventually decomposes to ammonia; ammonia, produced from organic decay by bacteria and fungi; nitrite, produced from ammonia by nitrite bacteria; and nitrate, the form which is most readily available for use by plants. Nitrate is produced from nitrous oxide by nitrate bacteria. In some ecosystems, nitrogen is the nutrient that limits algae growth.*

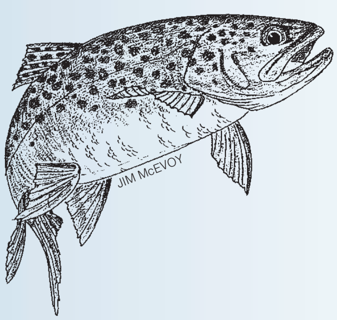
STRATIFICATION *• The layering of water due to differences in temperature and density.*

EPILIMNION *• The uppermost circulating layer of warm water that occurs in stratified lakes in summer because of the differences in water density. Water's greatest density occurs at 39°F. In lakes that stratify, as water warms during the summer, it remains near the surface while the colder water remains near the bottom. The depth of the epilimnion is determined by wind and usually extends about 20 feet below the surface.*

THERMOCLINE *• Sometimes referred to as the metalimnion. The narrow transition zone between the epilimnion and the hypolimnion that occurs in stratified lakes.*

METALIMNION *• Sometimes referred to as the thermocline. The narrow transition zone between the epilimnion and the hypolimnion that occurs in stratified lakes.*

HYPOLIMNION *• The cold, deepest layer of a lake that is removed from surface influences.*



that eventually are eaten by fish, ducks, and other animals. Too much phytoplankton can disrupt the natural balance of a lake ecosystem, make the lake unsightly, and make swimming and other activities less enjoyable. Certain kinds of blue-green algae, which are sometimes classified as bacteria, can cause noxious odors when it decays and can also produce natural toxins that can be dangerous to animals (including cows and dogs) and humans if ingested. If your lake has little turbidity due to sediment, the Secchi disc data you provide will give a relative estimate of how much algae is present in your lake. It will not reveal what types of algae are present.

Water Color

Some lakes, especially those near acidic wetlands such as bogs, may be stained brown like tea. This is an indication that the water contains tannic acid that leached from the surrounding vegetation. Since light does not penetrate as well through dark-colored water, Secchi depth may be low although algae may be less abundant. Plant densities may be lower in stained lakes since sunlight is not able to penetrate very deep into the water column. You may also notice a change in water color over the sampling season. Seasonal color changes most likely reflect changes in algae productivity. If your lake turns unusually green, brown, or orange for a few weeks during the summer months, the change is probably the result of an algal bloom. To fully understand variations in Secchi depth, water color observations over time must be recorded.

Mixing and Stratification

A lake's water quality and ability to support fish are affected by the extent to which the water mixes. Mixing will also impact your Secchi disc reading. The depth, size, and shape of a lake are the most important factors influencing mixing; although climate, lakeshore topography, inflow from streams, and vegetation also play a role (Shaw et al. 2000).

Water density peaks at 39°F. It is lighter at both warmer and colder temperatures. Variations in water density caused by different temperatures can prevent warm and cold water from mixing (Shaw et al. 2000). When lake ice melts in early spring, the temperature and density of lake water will be similar from top to bottom. This uniform water density allows the lake to mix completely, recharging the bottom water with oxygen and bringing nutrients to the surface (Shaw et al. 2000). This mixing process is called spring overturn. As surface water warms in the spring, it loses density. Due to physics, wind and waves can only circulate the warmed water 20 to 30 feet deep, so deeper areas are not mixed. If the lake is shallow (less than 20 feet), however, the water may stay completely mixed all summer (Shaw et al. 2000).

During the summer, lakes more than 20 feet deep usually experience a layering called **stratification**. Depending on their shape, small lakes can stratify even if they are less than 20 feet deep. In larger lakes, the wind may continuously mix the water to a depth of 30 feet or more. Lake shallows do not form layers, though deeper areas may stratify. Summer stratification, as pictured in Figure 1, divides a lake into three zones: **epilimnion** (warm surface layer), **thermocline** or **metalimnion** (transition zone between warm and cold water), and **hypolimnion** (cold bottom water). Stratification traps nutrients released from the bottom sediments in the hypolimnion (Shaw et al. 2000).

In the fall, the surface cools until the water temperature evens out from top to bottom, which again allows mixing (fall overturn). A fall algae bloom often appears when nutrients mix and rise to the surface. Winter stratification, with a temperature difference of only 7°F (39°F on the lake bottom versus 32°F right below the ice), remains stable because the ice cover prevents wind and waves from mixing the water (Shaw et al. 2000).

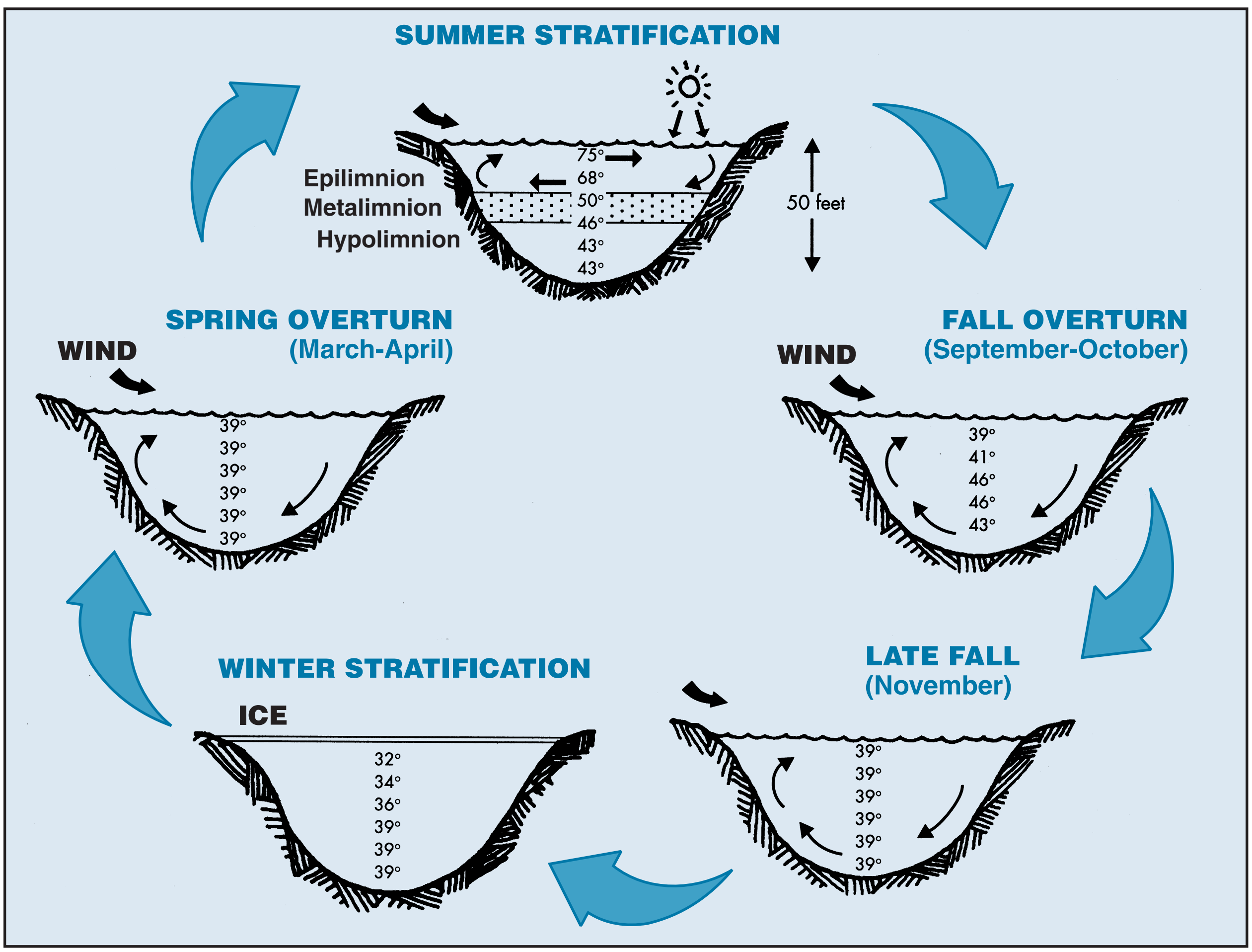
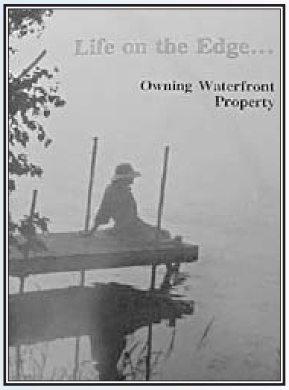


Figure 1. *Seasonal Stratification of Lakes. (Taken from Shaw et al. 2000 "Understanding Lake Data")*



FOR MORE INFORMATION ON HOW TO PROTECT AND ENHANCE YOUR LAKES, obtain a copy of

Life on the Edge… Owning Waterfront Property.

The 22 chapters give an overview of various topics such as living with wildlife, shore savers, or plant control. Copies are $10 each and can be ordered online at http://www.uwsp.edu/cnr/uwexlakes/publications/ or by calling (715) 346-2116.

SEEPAGE LAKES • *Lakes without a significant inlet or outlet, fed by rainfall and groundwater.*

ALGAL BLOOM • *A heavy growth of algae in and on a body of water as a result of high nutrient concentrations.*

The lake's orientation to prevailing winds can affect the amount of mixing that occurs. Some small, deep lakes may not undergo complete mixing in the spring or fall if there is not enough wind action. The mixing that takes place in the bays of a large lake will more closely resemble that of a small lake because the irregular shoreline blocks the wind (Shaw et al. 2000). Because mixing distributes oxygen throughout a lake, lakes that don't mix may have low oxygen levels in the hypolimnion, which can harm fish. Some fish species require lake stratification. The cold water in the hypolimnion can hold more oxygen than the warmer water in the epilimnion and thus provide a summer refuge for cold water fish (e.g., trout). If the lake produces too much algae that falls onto the lake bottom to decay, oxygen in this part of the lake will become depleted since the steep temperature gradient in the metalimnion will prevent any surface water with dissolved oxygen from reaching the bottom (Shaw et al. 2000).

A demonstration of overturn can be seen at **http://www.bellmuseum.org/distancelearning/greatlakes/goodies.html**.

Water Levels

Lake levels can fluctuate naturally due to precipitation which varies widely from season to season and year to year. While some lakes with stream inflows show the effect of rainfall almost immediately, others may not reflect changes in precipitation for months. For example, heavy autumn rains often cause water levels to rise in the winter when rain enters the lake as groundwater. Longer retention times occur in seepage lakes with no surface outlets. Average retention times range from several days for some small impoundments to many years for large **seepage lakes**. Lake Superior has the longest retention time of Wisconsin lakes – 500 years (Shaw et al. 2000).

Water level fluctuations can affect your lake water quality. Low water levels may cause stressful conditions for fish and increase the number of aquatic plants. High water levels can increase the amount of nutrients and sediments entering the lake due to runoff and increase the amount of sediment due to erosion. When groundwater levels are high, older septic systems that are located near lakes may flood (Shaw et. al. 2000). Low water levels may impact the lake's ability to stratify.

When lakes stratify, the thermocline (the mixing depth) prevents nutrients (especially phosphorus) from circulating throughout the lake, essentially trapping it near the bed of the lake in the deeper water areas. If water levels decrease and lakes do not stratify nutrients could circulate freely throughout the water column creating **algal blooms**. Low water levels can contribute to algal populations. When water levels are low, algae can take advantage of nutrients released from the sediments due to wave action. Normally these nutrients would be contained in deeper water.

Wind-generated Waves, Sun Position, and Cloud Cover

Wind-generated waves and boat wakes stir up sediments in shallow water areas. In addition, unprotected shorelines can erode and contribute suspended particles to the water. In shallow areas, wind-generated waves and boat wakes stir up sediments. Wind and boat generated waves breaking on shore also contribute to turbidity. These shoreline and shallow water impacts contribute to turbidity and can block out sunlight and thus affect photosynthesis.

A 1998 study conducted by Larson and Buktenica found that when the lake surface was calm and skies were clear or had high haze, differences between descending and ascending Secchi observations decreased slightly with increased disc depth. Waves from tour boats, drops of water from the research vessel, and wind generated ripples and chop decreased disc readings as much as 5 meters relative to readings recorded when the lake surface was calm. Furthermore, documenting the variation caused by slightly disturbed lake surface conditions relative to calm surface conditions and among trained observers ensures consistent interpretation of the long-term data (Larson and Buktenica 1998).

The distance of the observer from the water surface, cloudiness and other weather conditions, the height of the sun on the horizon (ideally, volunteers collect data when the sun is directly overhead), and glare at the water's surface all affect your Secchi disc reading. CLMN monitoring protocols are set up to make sure that lake data is comparable and to eliminate as many extenuating circumstances as possible.

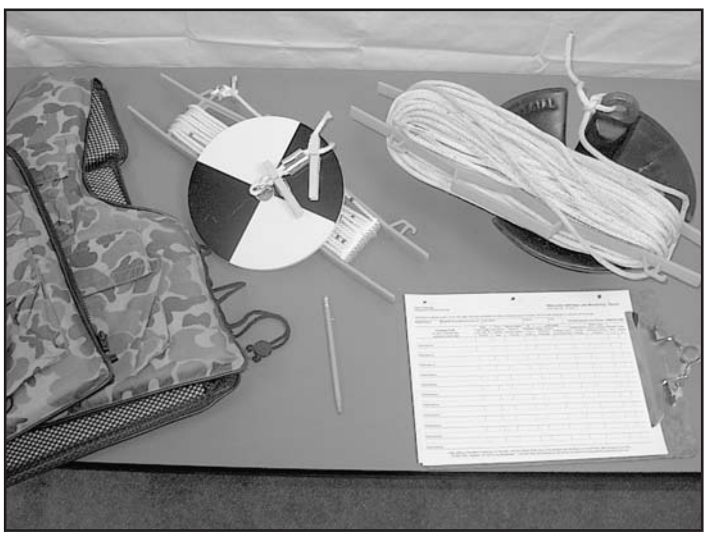
Motor Boat Activity

Propellers of boats may disturb the lake or river bottom directly, or indirectly through the wash or turbulence they produce, especially in shallow water. This may affect water clarity by increasing the amount of sediment particles in the water or may cause nutrients, such as phosphorus, that are stored in the sediments, such as phosphorus, to become available for algal growth. Waves created by watercraft may contribute to shoreline erosion, which can cloud the water. Boats have been shown to affect water clarity and can be a source of nutrients and algal growth in aquatic ecosystems. Shallow lakes, shallow parts of lakes and rivers, and channels connecting lakes are the most susceptible to impacts. Depth of impact varies depending upon many factors including boat size, engine size, speed, and substrate type. Few impacts have been noted at depths greater than 10 feet (Asplund 2000).

NOTES

1. SECCHI (Water Clarity) MONITORING

Before you start sampling, be sure to read the following pages to familiarize yourself with the equipment and the procedures that you will be using. *All of the procedures that you will follow in sampling your lake are done for specific reasons. It is very important that you follow the sampling procedures exactly as they are laid out in the following pages to ensure good, consistent, high quality data. The following pages will provide you with sufficient background on the design of the equipment and proper procedures to use.*



DNR PHOTO

After sampling, it is very important to rinse and air dry thoroughly all of the equipment that you used. As always keep paperwork and envelopes separate from equipment.

What Equipment Will You Need?

At your training session, your CLMN regional coordinator will outline and provide all of the equipment that you will need to successfully monitor your lake.

- ☑ Secchi disc (with rope and holder)
- ☑ Two clothespins
- ☑ Lake map with sampling site marked
- ☑ Life jackets (you provide)
- ☑ Anchor and rope (you provide)
- ☑ Boat (you provide)
- ☑ Field data sheets
- ☑ Pencil and waterproof pen

SHOULD I COLLECT SECCHI DATA IN THE WINTER?

Secchi measurements taken through the ice are highly variable depending on the amount of snow on the ice and ice clarity (i.e. did it freeze fast or was there slush on the lake that froze and created "cloudy" ice). These are the main factors that determine the amount of light that can get through the ice which allows you to take accurate measurements. Since algae production is at a minimum under the ice, this data has no real value for Network use.

Waterbody # or WBIC (Waterbody Identification Code) • *A unique identification number the Wisconsin DNR uses to identify each waterbody in the state. Every one of the 15,000 lakes in Wisconsin has a unique WBIC.*

Station # (or Storet #) • *A number assigned to sampling locations on a waterbody. The station identification number makes it easy to track secchi and chemistry data. Each sampling site on a lake will have a separate station identification number.*

VOLUNTEER IDENTIFICATION NUMBER
All data collected in CLMN is tied back to an individual's volunteer id number. Necessary if one wishes to enter data into the database.

How Do You Prepare to Sample?

The Day You Sample

On the day you plan to sample, complete the top portion of your field data sheet by filling in the **waterbody # (or WBIC)** "**Station # (or storet #)**," sections. Enter the name of each volunteer who will be sampling or their **volunteer id** number. If you do not know what these numbers are contact your CLMN regional coordinator. Before you launch your boat, make sure you have your Secchi disc, an anchor, and personal flotation devices (life jackets) in your boat before proceeding to your sampling site.

Sampling Overview

When to Take Your Secchi Readings

The weather can affect the depth at which you can no longer see the Secchi disc. Wind-generated waves, sun position, and cloud cover are major weather factors that can affect the accuracy of your readings.

- Ideally, Secchi readings should be taken every 10 to 14 days.
- Ideally, Secchi readings should be taken on clear, calm days between 10 am and 4 pm.
- Anchor the boat.
- Secchi disc readings are taken on the shady side of the boat.
- Kneel or sit so you are close to the surface of the water.
- Remove your sun glasses – sun glasses can increase the depth that you can see your Secchi disc. For consistency and so we can compare data from one lake to another, please remove your sun glasses.
- Use clothespin method to determine accurate reading.
- For color and clear/murky determination, hold Secchi disc one foot below the surface of the water.

To make sampling regular and convenient, try to make it a part of your weekly routine. You can include it as part of your weekend fishing trip or family outing on the lake. The most important time to collect your Secchi data is in July and August. These are the prime months for lake recreation and the time when algae is the most prevalent. Secchi analysis statewide relies on information for these months and will appear in your statewide summary. Averages of Secchi data recorded during July and August will appear in your statewide summary report. Due to seasonal variation, the entire years' Secchi disc data cannot be averaged.

The Secchi readings you take in the spring and fall will tell a story about your lake. These readings can tell you when spring runoff occurs in your lake or when there are algal blooms. For this reason, many Secchi volunteers may start collecting data in April and continue through November. But for a variety of reasons other volunteers may choose to start in June and only continue sampling through September.

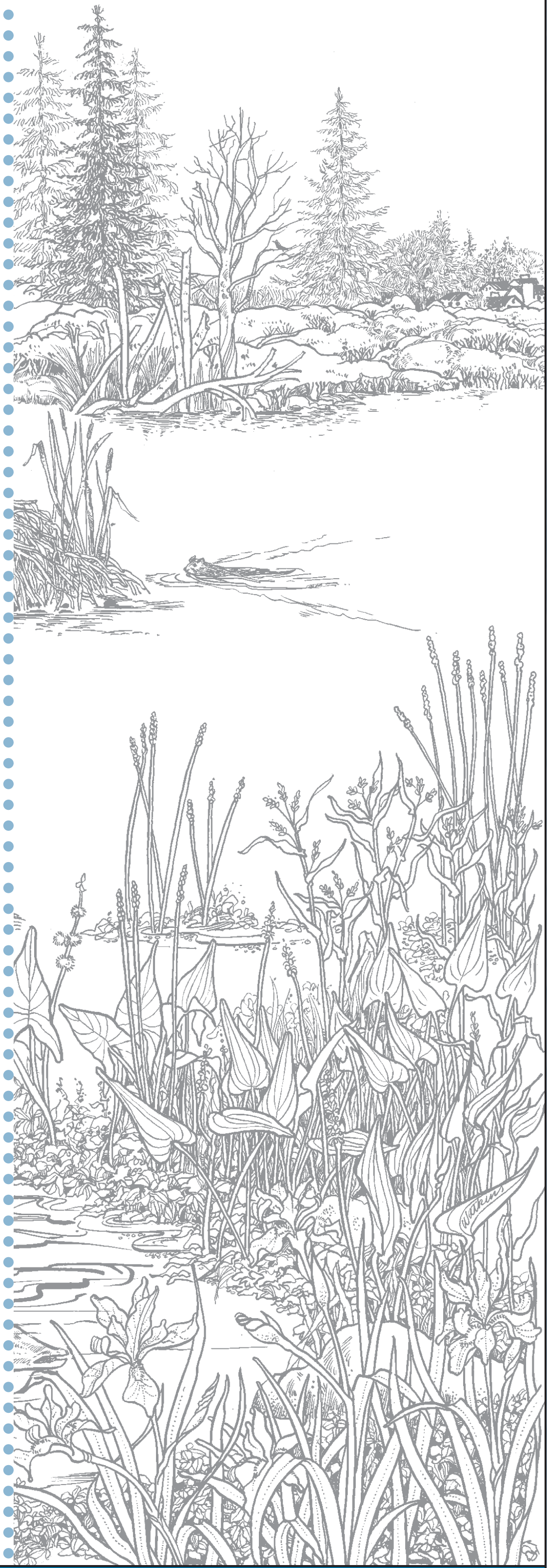
If you are unable to sample during your normally scheduled sampling time, do not worry about it! Just try to sample as soon as possible after that time. However, if you think that you will not be able to continue monitoring your lake due to illness, schedule conflicts, or other problems, please contact your CLMN regional coordinator as soon as you can.

Some states collect Secchi readings differently than Wisconsin volunteers do. Some monitoring programs use different sized and colored discs. Some states use unmarked ropes. Some monitor on the sunny side of the boat. The most important thing is that Wisconsin CLMN volunteers remain consistent in monitoring protocols. If we change our protocols we may not be able to compare future data to existing data.

Remote Sensing Project

Since 1999, CLMN volunteers have assisted in a collaborative research effort with University of Wisconsin Environmental Remote Sensing Center by taking secchi readings on dates when the satellites were overhead. The volunteers' participation has allowed the University to successfully calibrate computer programs that enable satellite imagery to be used to predict Secchi disc depth and other water quality parameters on lakes without volunteers. The researchers at the Remote Sensing Center are continuing their research. The ultimate goal is to put the satellite data into everyday use by making the water clarity data derived from the satellite imagery available to the Wisconsin DNR and to the public. Volunteer participation is and will continue to be essential to this effort.

We participate in the study from July 1 to September 15. Each lake is assigned a path number. This path number will let you know the dates when the satellite will be overhead. Go out on any of these days you can and sample your lake as you normally would, preferably on clear, calm sunny days. There is no need to let us know that you sampled for the satellite experiment, just report your data as you normally do. For paths and sampling dates please visit **http://dnr.wi.gov/lakes/CLMN/remotesensing/**.



CAROL WATKINS, UW-EXTENSION, ENVIRONMENTAL RESOURCES CENTER

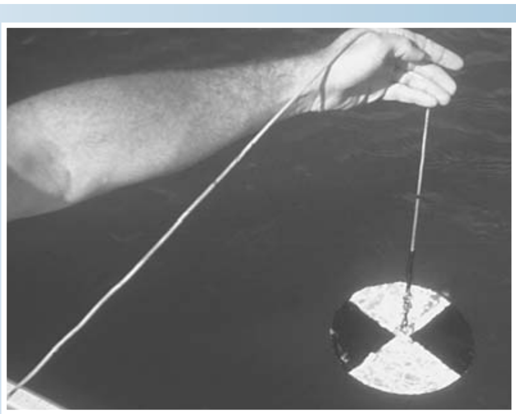
ON LAKE PROCEDURES
How to Use the Secchi Disc

STEP 1. Before going out to take your Secchi disc readings, be sure the conditions are right for sampling. Ideal weather conditions include sunny or partly sunny/cloudy skies; wind-calm to breezy (there should be no whitecaps on the lake). Collect Secchi measurements between 10 am and 4 pm. If possible, try to collect Secchi readings when the satellite is overhead. Satellite paths are available at **http://dnr.wi.gov/lakes/CLMN/remotesensing/**.

STEP 2. Your CLMN regional coordinator will provide you with a lake map with the sampling site marked. Be sure you have a station id number for each site you are monitoring.

STEP 3. Anchor your boat at your sampling site to prevent drifting. Be careful not to disturb the sediments on the lake bottom when anchoring since this could cloud the water. ***Remove your sun glasses.*** **Wearing sun glasses will give you an unnatural reading.** Unwind the Secchi disc rope from the holder.

STEP 4. Lean over the shady side of the boat and slowly lower the Secchi disc into the water until you can no longer see it. If you are sampling in a pontoon boat, be sure to kneel down on the floor of the boat when you take your readings so you are closer to the surface of the water. Be as close to the surface of the water as you can safely be. Secchi disc readings are taken on the shady side of the boat to reduce glare.



STEP 5. When the Secchi disc barely disappears from your view, mark the rope at the surface of the water with a clothespin.

DNR PHOTOS

ON LAKE PROCEDURES

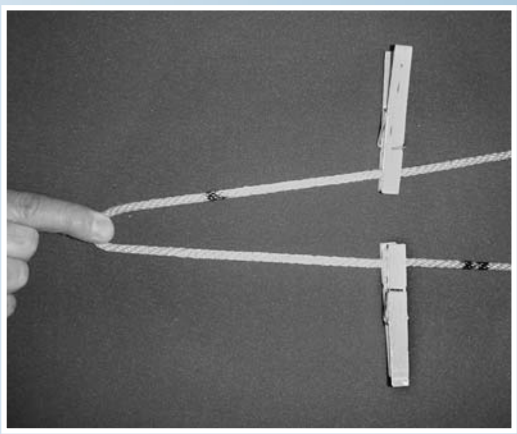
How to Use the Secchi Disc (continued)

STEP 6. After you have marked this spot with the clothespin, lower the disc a few more feet into the water. Slowly raise the disc. When the Secchi disc reappears, mark the rope at the surface of the water with the second clothespin. The clothespin marks may be at the same spot, several inches or even several feet apart. The purpose of lowering the Secchi disc and raising it back into view is so your eyes become accustomed to looking into the water. The average of the two readings will be a more accurate result.

DNR PHOTO

STEP 7. Bring the Secchi disc back into the boat.

STEP 8. Average your two Secchi disc readings by forming a loop between the two clothespins. Slide one clothespin into the center of the loop to mark it. Remove the other clothespin. The remaining clothespin mark will be your Secchi reading.



JIM KLOSIEWSKI

STEP 9. Your rope is marked in foot increments. The red lines indicate five, fifteen, and twenty-five feet. The double black lines indicate ten, twenty, and thirty feet. Carefully measure the number of feet from the disc until you reach your clothespin mark. Round off to the nearest quarter foot.

STEP 10. Record this measurement on your data sheet and then fill out the rest of your data sheet.

(continued on next page)

ON LAKE PROCEDURES

How to Use the Secchi Disc (continued)

STEP 11. Record your perception of water color and water appearance. Hold the Secchi disc one foot under the surface of the water to determine color and appearance. Record perception. This is your perception of the amount of algae that is in the water at the deep hole.

Perception Numbers

1 - Beautiful, could not be any nicer.

2 - Very minor aesthetic problems, excellent for swimming and boating.

3 - Swimming and aesthetic enjoyment of lake slightly impaired.

4 - Desire to swim and level of enjoyment of lake substantially reduced because of algae (would not swim, but boating is okay).

5 - Swimming and aesthetic enjoyment of the lake substantially reduced because of algal level.

STEP 12. If you are taking Secchi readings at more than one site or lake, proceed to your next location and repeat steps 1 through 10 above (step 11, perception, is recorded at the deep hole only.)

STEP 13. Report your data. Data can be submitted on the Internet at **http://dnr.wi.gov/lakes/clmn-data**. Internet instructions are found in Appendix 2, page 50. If you enter data online, you do not need to submit data sheets by mail. Data can also be submitted by phone at (888) 947-3282. If reporting data by phone, copies of your data should be mailed to Madison. Observations can't be entered by phone, they have to be entered later using your hard copy.

For those without Internet access or phone access – data sheets can be mailed to your CLMN regional coordinator to be entered into the database or mailed to the central office in Madison:

Department of Natural Resources, Lakes WT/4
101 S. Webster St.
P.O. Box 7921
Madison, WI 53791-9087

Taking Care of Data

Once you are back on shore, transfer all your data to the data form. This form will make it easier for you to enter your data online or submit it using the Secchi line phone system. After entering your data into the DNR database, fill in the column labeled "*Date Entered*" on your data form. This will allow you to keep track of what data you have already entered.

Online

The web address to enter your data online is **http://dnr.wi.gov/lakes/clmn**. Choose the "Submit Data" link located on the left side of the page. You will need a user name and password to enter data. Instructions for obtaining a user name and password are found at the CLMN website **http://dnr.wi.gov/lakes**. If you enter your data online, there is no need to mail in a paper copy. If you need assistance getting set up to enter data online, contact Jennifer Filbert at **Jennifer.Filbert@wisconsin.gov**.

By Telephone

If you don't have Internet access, you can still enter your data using the Secchi line phone system. The toll-free number is (888) 947-3282. If at any time you have problems trying to enter your data using the Secchi line phone system, press 9 to speak to someone in the central office. If you enter your data by phone, keep the pink copy of the data form for yourself and use the business reply envelope provided to you to send the blue copy to the Madison DNR office (Citizen Lake Monitoring, WT/4, Wisconsin DNR, 101 S. Webster St., PO Box 7921, Madison, WI 53707-7921) by November 1. DNR staff will enter your observations for you.

All data for the year must either be entered online or into the Secchi line phone system by November 1st to guarantee that it will be included in reports and analyses done in the winter and spring. If you find data that has not been entered after this date you can still enter your data online or you can mail your data sheets to Citizen Lake Monitoring, WT/4, Wisconsin DNR, 101 S. Webster St., PO Box 7921, Madison, WI 53707-7921. Staff will make sure that your data is entered into the database.

If you are unable to enter data on the Internet or by phone, mail the blue copy of your carbonless form to either your CLMN regional coordinator or to the Madison central office (there are self addressed envelopes in your manual).

DNR PHOTO

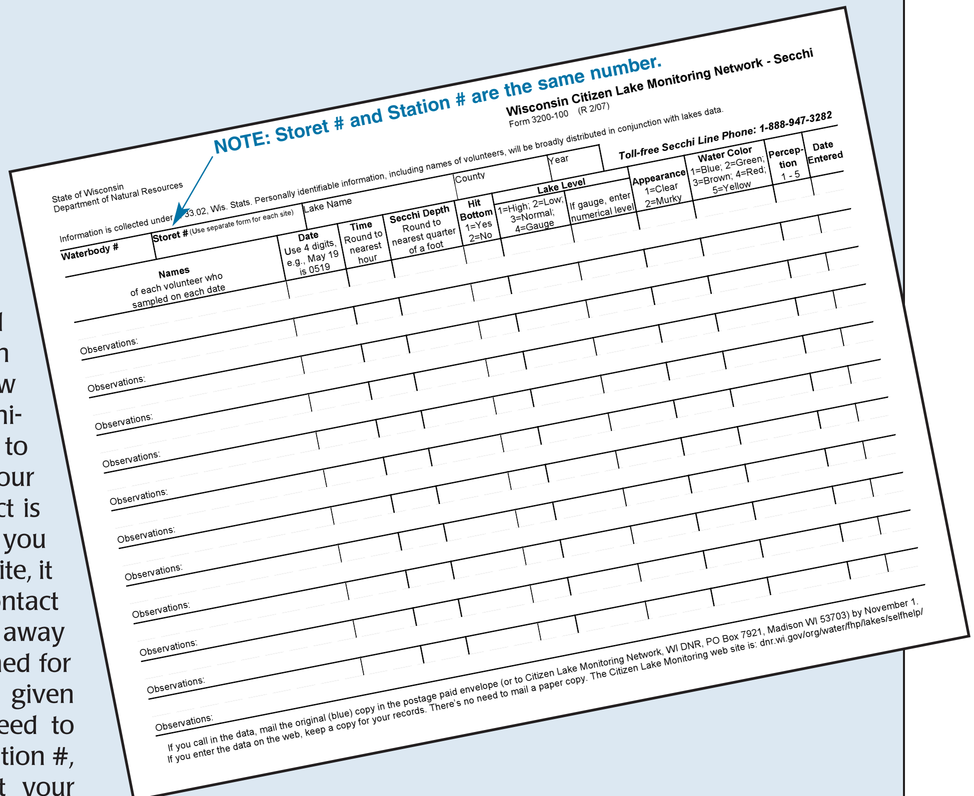
During the winter, you will receive an email or postcard reminding you that reports featuring the data you collected are available online. If you do not have an email address, lake summary reports will be mailed to you. Limnologists suggest that after eight years of collecting Secchi data, one can begin to determine if water clarity is getting better, worse, or staying the same. Your reports will show the dates you sampled, and your Secchi disc readings measured in feet and meters. Always check your annual report with a copy of your original data sheet to verify your data.

HOW TO FILL OUT YOUR FIELD DATA SHEET

During your training session, you should have received:

- A waterbody identification code (WBIC) *(only needed if you phone in your data on the Secchi Line)*
- Station # (or Storet #)
- Volunteer ID number

The WBIC is a number assigned to your lake and allows the Citizen Lake Monitoring Network to know exactly which lake you are monitoring. The Station # is assigned to the specific monitoring site on your lake and the data that you collect is tied to that specific number. If you decide to change your sampling site, it is very important that you contact your regional coordinator right away so a new Station # can be assigned for that site. Each volunteer is also given their own ID number. If you need to know your WBIC number and Station #, or volunteer ID, please contact your regional coordinator or central office staff to obtain it. While you are sampling on your lake, record all of your data on the white "Field Data Form". You can use this same form for repeated sampling days until it is filled up, or too wrinkled from wind and water to use anymore. However, if you change sampling site locations within a lake or change lakes, you must use a new form!



NOTE: Storet # and Station # are the same number.

State of Wisconsin
Department of Natural Resources

Wisconsin Citizen Lake Monitoring Network - Secchi
Form 3200-100 (R 2/07)

Information is collected under s. 33.02, Wis. Stats. Personally identifiable information, including names of volunteers, will be broadly distributed in conjunction with lakes data.

Waterbody #	Storet # (Use separate form for each site)	Lake Name	County	Year

Toll-free Secchi Line Phone: 1-888-947-3282

Names of each volunteer who sampled on each date	**Date** Use 4 digits, e.g., May 19 is 0519	**Time** Round to nearest hour	**Secchi Depth** Round to nearest quarter of a foot	**Hit Bottom** 1=Yes 2=No	**Lake Level** 1=High; 2=Low; 3=Normal; 4=Gauge	If gauge, enter numerical level	**Appearance** 1=Clear 2=Murky	**Water Color** 1=Blue; 2=Green; 3=Brown; 4=Red; 5=Yellow	**Perception** 1 - 5	**Date Entered**
Observations:										
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If you call in the data, mail the original (blue) copy in the postage paid envelope (or to Citizen Lake Monitoring Network, WI DNR, PO Box 7921, Madison WI 53703) by November 1.
If you enter the data on the web, keep a copy for your records. There's no need to mail a paper copy. The Citizen Lake Monitoring web site is: dnr.wi.gov/org/water/fhp/lakes/selfhelp/

The following descriptions represent the portions of your data sheet that can be filled out while you are on the shoreline or before you get into your boat. Data sheets can be found online at http://dnr.wi.gov/lakes/forms.

Date

When recording the date it is only necessary to use 4 digits. For example, if you sampled on May 19th, you would record this on your data form as "0519"; July 6th would be "0706", etc. You do not need to include the year since your data is submitted annually.

Time

Record the time you started your sampling. If you are going to report your data using the Secchi line, you should record it in "military" time (e.g., 1:05 P.M. is 135 hours). If you are reporting your data online, you can record your "civilian" time as you normally would by using A.M. and P.M.

Lake Level

Record the water level on your lake. It helps to use the shoreline or your pier as a guide to indicate whether your lake level is high, low, or normal. If you are able to determine the water level using a staff gauge on the lake, indicate this on the data sheet and record the numerical value in the space provided.

The following descriptions should be filled out while you are on the water at your sampling site so the observations are fresh in your mind.

Secchi Depth

When recording your Secchi disc reading, round off to the nearest quarter foot. Record fractions of a foot as a decimal since this is how it will be entered in the Secchi line phone system or online. For example, 12 1/4 feet is 12.25 feet. **Note**: The "*" (star) button on your telephone key pad serves as the decimal point when entering your data into the Secchi line phone system. It is possible that the Secchi disc will be visible even when it is resting on the bottom of the lake. If this is the case, record the depth as you always would, but make sure you record a "1" in the "Hit Bottom" field of your data sheet.

Appearance

To determine if the water appearance is clear or murky, hold your Secchi disc one foot under the surface of the water and observe how the white part of the disc appears.

Water Color

The water color is determined at your site using the Secchi disc as a guide. After lowering the disc about a foot into the water, ask yourself the question, "Does the white part of the Secchi disc look white, or does it appear green or brown?" If it appears white, then the water color is "blue." If it appears green, then the water color is "green" and so on. If you are using color cards to determine the color of your lake water, then the white part of the disc would be compared to the colors on the card and a numeric value assigned to the color. Be aware that the online data entry form and Secchi Line only accept one color, for instance, if the water appears "bluish-green," you will have to select the one color (blue or green) that best describes your water color.

Perceptions

Indicate your perception of the water quality for your lake at the deep hole. **Refer only to the condition of the water itself.** You can record information on aquatic plants around the shoreline or other problems you perceive in the observation section of the data sheet. On a scale of 1 to 5 (1 being the best and 5 being the worst), your perception of the water should reflect how much algae is in the water.

1 - Beautiful, could not be any nicer

2 - Very minor aesthetic problems; excellent for swimming and boating enjoyment

3 - Swimming and aesthetic enjoyment of lake slightly impaired because of high algae levels

4 - Desire to swim and level of enjoyment of lake substantially reduced because of algae (would not swim, but boating is OK)

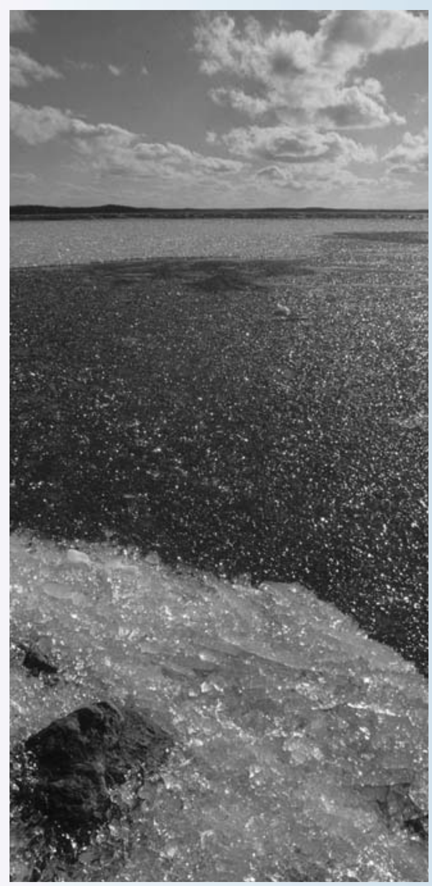
5 - Swimming and aesthetic enjoyment of lake substantially reduced because of algae levels

Observations

In the observation section of the data sheet, you can include any comments about the weather, water conditions, wildlife sightings, plant densities, or other information you want to include that you think will help to better understand your lake. If you need more data sheets, have questions or problems, you may also include those comments in this section. Feel free to attach additional observations on a separate sheet of paper. You can enter as much information as you'd like. The database is capable of holding a very long entry.

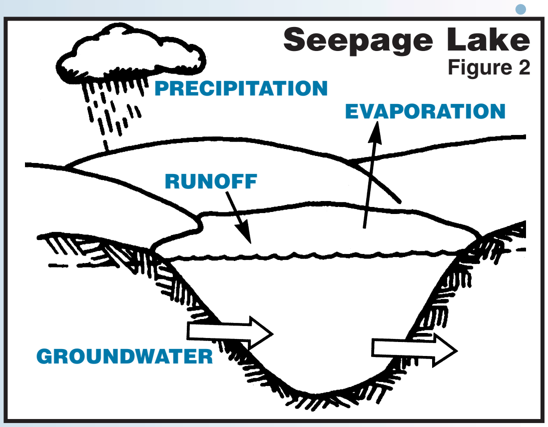
HOW TO REPORT ICE ON/OFF INFORMATION

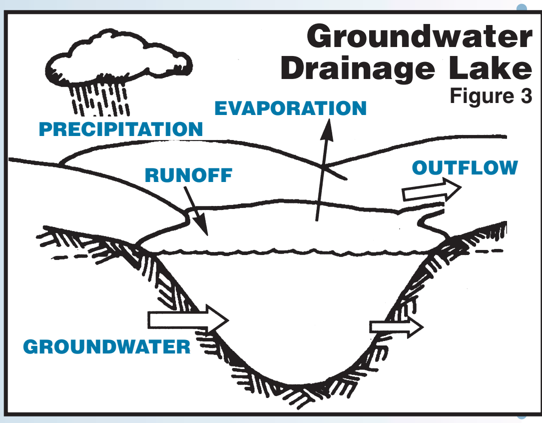
You can report your ice observations online through SWIMS. After you log in, choose the Ice Observations project for your lake. There are two forms: one for reporting "Ice On" and one for reporting "Ice Off". The corresponding paper forms can be found at http://dnr.wi.gov/lakes/forms/. For historical analyses, the official ice on date should be the first date of complete ice cover and the official ice off date should be the first breakup. You can document additional freeze and thaw dates in the comments box. See ice on/ice off data sheets in Appendix 3, page 51.

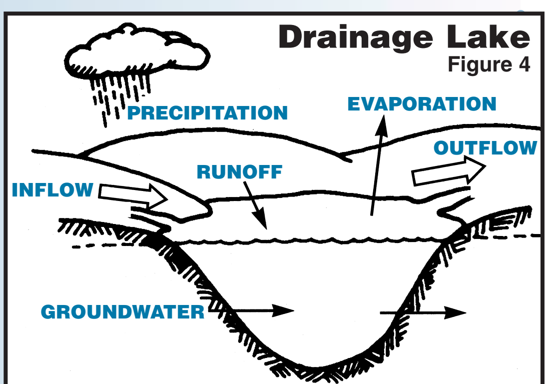


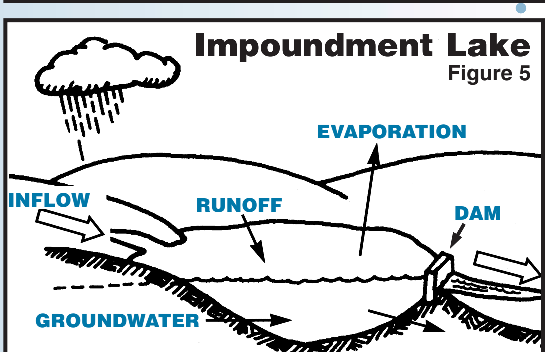
ROBERT QUEEN

Figures 2-5. ***Lake Types.*** *Major water inputs and outflows of different lake types. Large arrows indicate heavy water flow. (Taken from Shaw et al 2000 "Understanding Lake Data")*









Understanding Your Data

When you receive your annual report, the first thing you should do is check for errors. The easiest way to do this is to compare your report to your original records. If you find an error, please notify Jennifer Filbert at (608) 264-8533 or by email at **Jennifer.Filbert@wisconsin.gov**. You can also mail your corrections to: Citizen Lake Monitoring, WT/4, 101 S. Webster St., PO Box 7921, Madison, WI 53707-7921.

Before you review your results there are some basic things you should note about your lake: the lake type and lake **georegion**. This information can be found at the very top of your annual report. Since lakes of the same type located in the same georegion are usually comparable to one another, this information is important when comparing your lake to others.

Lake Types

The physical characteristics of a lake can greatly influence its water quality. Two factors are especially important: the primary source of the lake's water along with its flushing rate and whether or not the lake is stratified in the summer.

Seepage lakes are fed mainly by precipitation and runoff, supplemented by groundwater from the immediate drainage area. These lakes do not have an inlet or permanent outlet. Seepage lakes are the most common lake type in Wisconsin. Many seepage lakes are low in nutrients, acidic, and susceptible to acid rain. These lakes usually have small watersheds (Figure 2).

Groundwater drainage lakes, often referred to as spring-fed lakes, are fed by groundwater, precipitation, and limited runoff. Spring-fed lakes have a permanent outlet, but no inlet. The primary source of water for spring-fed lakes is groundwater flowing into the bottom of the lake from inside and outside the immediate surface drainage area. Spring-fed lakes are located at the headwaters of many streams and are a fairly common type of lake in northern Wisconsin. These lakes are usually well buffered against acid rain and contain low to moderate amounts of nutrients. These lakes have small watersheds (Figure 3).

Drainage lakes are fed by streams, groundwater, precipitation, and runoff. These lakes have an inlet and an outlet, and the main water source is stream drainage. Most major rivers in Wisconsin have drainage lakes along their course. Water quality in drainage lakes can be highly variable. These lakes often have large watersheds (Figure 4).

Impoundments are man-made lakes or reservoirs made by damming a stream or river. An impoundment is drained by a stream or river. Because of nutrient and soil loss from upstream land use practices, impoundments typically have higher nutrient concentrations and faster sedimentation rates than natural lakes (Figure 5).

Lake Georegions

Wisconsin's lake georegions first originated from a grouping of lakes made in the early 1980s by Wisconsin DNR senior limnologists. These first groupings were based on the best professional judgment of the scientists most familiar with Wisconsin's lake resources. The georegions roughly reflect "hydro-chemical lake regions" which are based on the state's bedrock geology, glacial geology, and soil type; and more recently described ecoregions which are based on geological characteristics and dominant vegetation (Figure 6).

The ***northwest georegion*** is lake-rich. Most of the lakes found here are relatively small (i.e., less than 100 acres). They are usually natural lakes and many have extensive wetlands. Many "stained" lakes are found in this georegion. In general, the lakes in this georegion have low phosphorus levels and are moderately free of sediment. However, lakes in Polk, St. Croix, and Barron counties tend to be shallow and more eutrophic. For this reason, chlorophyll concentrations and water clarity both vary considerably in northwest georegion lakes.

Thirty seven percent of Wisconsin's lakes are found in the ***northeast georegion***. Many are natural "stained" lakes and tend to be clustered with extensive wetlands. Lake size varies considerably. Lakes in the northeast georegion tend to be deeper than lakes in other georegions. As a group, northeastern lakes have low phosphorus and chlorophyll levels and tend to have the greatest water clarity when compared to lakes in the other four georegions.

The ***central georegion*** forms a distinct lake group in Wisconsin. In a large part of this georegion, lakes are

GEOREGION • *Wisconsin's lake "georegions" originated from a grouping of lakes made in the early 1980s by Wisconsin DNR senior limnologists. These groupings are based on the best professional judgment of the scientists most familiar with Wisconsin's lake resources. The georegions roughly reflect "hydro-chemical lake regions" which are based on the state's bedrock geology, glacial geology and soil type, and the more recently described "ecoregions" which are based on geological characteristics as well as the dominant vegetation.*

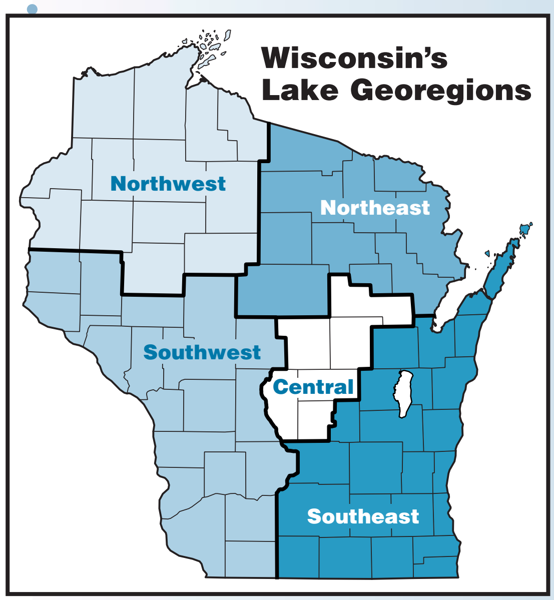


Figure 6. *Wisconsin's lake georegions.*

Average summer TSI values for different lake georegions. *Averages were calculated from Secchi measurements recorded in June, July, and August 2004.*

Lake Georegion	TSI Value
Northwest	45
Northeast	43
Central	44
Southwest	58
Southeast	49

WATER SOURCE

The source of a lake's water supply is very important in determining its water quality and in choosing management practices to protect that quality. If precipitation is a major water source, (e.g., a seepage lake) the lake will be acidic, low in nutrients, and susceptible to acid rain (Shaw et al. 2000).

If groundwater is the major water source, the lake is usually well buffered against acid rain and contains low to moderate amounts of nutrients. Local septic systems or other groundwater contamination could cause problems. Water exchange is fairly slow creating long residence times for nutrients. (Shaw et al. 2000).

If streams are the major source of lake water, nutrient levels are often high and water exchange takes place more rapidly. These lakes have the most variable water quality depending on the amount of runoff and human activity in the watershed (Shaw et al. 2000).

Managing the watershed to control the amount of nutrients and soil that enter a lake is essential to protecting water quality. Controlling runoff (water that runs from the land's surface into the lake) is important for drainage lakes and impoundments, and some seepage and groundwater lakes. Protecting groundwater quality is particularly important for seepage and groundwater drainage lakes (Shaw et al. 2000).

Watershed management becomes especially critical in impoundment lakes. If a stream is dammed the natural movement of water will be restricted, causing soil and nutrients to collect in the impoundment (Shaw et al. 2000).

Lake managers will measure the inflow and outflow of a lake to determine its water budget. As shown in the formula below, a water budget consists of several elements. The average precipitation in Wisconsin is 30 inches per year. Evaporation depends on the type of summer weather, but is usually about 21 inches. Groundwater flow is more difficult to measure, but can be estimated (Shaw et al. 2000).

The water budget can be expressed in percent or volume. A typical water budget for a drainage lake may look something like this:

Groundwater inflow (30%)
+ Precipitation (10%)
+ Surface runoff (60%)
= Groundwater outflow (5%)
+ Evaporation (11%)
+ Stream outlet (84%).

scarce due to the nature of the underlying soil and bedrock. Most central georegion lakes are small (i.e., less than 100 acres) and tend to have small watersheds. Most have low phosphorus, low chlorophyll concentrations, and high water clarity.

Large, shallow, eutrophic lakes and impoundments are found in the ***southwest georegion***. Natural lakes are scarce because of the topography and geological history since much of this georegion lies in the driftless area (a highly eroded and unglaciated landscape). Most lakes in this georegion are shallow and do not stratify in the summer. Lakes in the southwestern georegion tend to have high phosphorus and chlorophyll levels, and as a result, low water clarity.

Lakes and bogs are common in the ***southeast georegion***. This georegion has more large lakes (i.e., greater than 1000 acres) than the other four georegions and also has many shallow lakes. Lakes in the southeastern georegion tend to exhibit high phosphorus and chlorophyll levels along with low water clarity.

What Do My Secchi Readings Mean?

On a statewide level, a Secchi reading of greater than 20 feet is considered excellent water clarity. A reading of less than 3 feet is considered very poor. The water clarity that can be expected of a lake varies widely depending on the location, lake type, and historical conditions. For example, if the data shown in the following table was presented in your annual report, a good way to describe your water clarity might be to say that "The 2002 average summer water clarity on Lake Seventeen in Oneida County was 12 feet. Lake Seventeen was slightly less clear than other stratified lakes in the northeast georegion since the northeast georegion summer water clarity average was 13 feet."

Average summer Secchi values for different lake georegions. *Averages were calculated from Secchi measurements recorded in July and August 2004.*

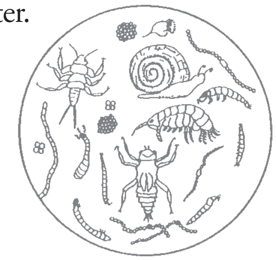
Georegion	Average Secchi depth (ft.) for mixed lakes	Average Secchi depth (ft.) for stratified lakes
Northwest	6.5	10.7
Northeast	7.4	12.8
Central	8.1	10.8
Southwest	3.4	4.7
Southeast	3.6	4.7

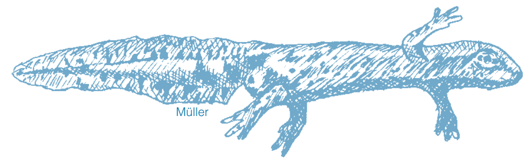
What Can I Learn From the Variation in My Secchi Readings?

Was your lake clearest in the spring and gradually became murky as the summer progressed? This trend might suggest that the lake is receiving a constant supply of nutrients, either from the watershed or from the lake sediments. This nutrient supply could be what is fueling the algal growth you are seeing throughout the summer.

If your lake water became clearer as the monitoring season went on, nutrients might be coming into the lake mainly in the spring with snowmelt. But as the summer progresses, there is no nutrient supply and algal growth is slowed.

If you see a sharp increase in your lakes water clarity in May or June, it may be that tiny grazing animals, called zooplankton, are eating the algae. When zooplankton are abundant, they can actually be seen as tiny dark dots swimming over the white part of the Secchi disc when it is submerged. These animals help decrease the amount of algae in the water, but are grazed on by minnows and other fish (e.g., bluegills, perch, crappie, etc.). If fish species that eat zooplankton become too abundant, often due to over-fishing of predator fish (i.e. bass), then the zooplankton population can decrease and the algae can become more abundant. The reason why zooplankton are more abundant in the spring is because fish that feed on them are not as active in the cooler water.





What is Trophic State?

Taking just one Secchi disc reading may not have much value since it measures the water clarity of the lake only on that one occasion. The time you sampled might have been during an algae bloom or it could have been after a heavy rainfall; both of which do not represent typical conditions. Secchi data collected regularly over time at or near the same location will provide the most accurate picture of your lake. Your data should vary over time because a lake is an ever-changing system. By taking regular measurements during the ice-free period you can determine the normal seasonal variations for your lake and its overall condition.

Your Secchi depth results, along with phosphorus and chlorophyll data (if available), allow a determination of the level of nutrient enrichment of the lake (i.e., trophic status). The Trophic State Index (TSI) is a continuum scale of 0 to 100, corresponding with the clearest and most nutrient poor lake possible, to the least clear and most nutrient rich lake (Table 1, page 36). Lakes can be divided into three main levels of nutrient enrichment categories. Oligotrophic, or nutrient poor lakes, are characterized by very high Secchi depths, plenty of oxygen in deep water, and may have cold-water fish species living in them. Mesotrophic lakes fall in the middle of the continuum from nutrient-poor to nutrient-rich. They have moderately clear water, and may experience low to no oxygen concentrations in bottom waters. Nutrient-rich lakes are called eutrophic. They have decreased Secchi disc readings and experience low to no oxygen in the bottom waters during the summer. These lakes would only be habitable for warm water fish. They may also experience blue-green algae blooms. Lakes that are super-enriched fall into an additional fourth category termed hypereutrophic. These lakes experience heavy algae blooms throughout the summer, and may even experience fish kills. Rough fish dominate in hypereutrophic lake systems.

TABLE 1. *The Trophic State Index (TSI) continuum.*

TSI less than 30
Classic oligotrophic lake characterized by clear water, many algal species, oxygen throughout the year in bottom water, and cold water oxygen-sensitive fish species in deep lakes. Excellent water quality.

TSI 30-40
Deeper lakes will still be oligotrophic, but the bottom waters of some shallower lakes may become oxygen-depleted during the summer.

TSI 40-50
Classic mesotrophic lake. characterized by moderately clear water, but increasing chance of low dissolved oxygen in deep water during the summer.

TSI 50-60
Lake becoming eutrophic characterized by decreased clarity, fewer algal species, and oxygen-depleted bottom waters during the summer. Plant overgrowth evident, supporting only warm-water fisheries.

TSI 60-70
Becoming very eutrophic. Blue-green algae may become dominant with possible algal scums. Extensive plant overgrowth problems likely.

TSI 70-80
Lake becoming hypereutrophic characterized by heavy algal blooms throughout summer, dense plant beds limited by light penetration.

TSI > 80
Hypereutrophic lake with very poor water quality, algal scums, summer fish kills, and few plants.

OLIGOTROPHIC • *Lakes characterized by low nutrient inputs and low productivity. They are generally deep with high water clarity.*

MESOTROPHIC • *Lakes characterized by their moderately fertile nutrient levels. Falls in between the oligotrophic and eutrophic levels of nutrient enrichment.*

EUTROPHIC • *Lakes characterized by high nutrient inputs, high productivity, often experiencing algal blooms and abundant weed growth. This term can also refer to a nutrient-rich lake, as large amounts of algae and weeds characterize a eutrophic lake.*

After a few years of collecting Secchi data, you will be able to answer two major questions about your lake.

1. *What is the trophic state of my lake based on water clarity data alone? (Is my lake generally more* ***eutrophic****,* ***mesotrophic****, or more* ***oligotrophic****?)*

2. *Is the water quality of my lake improving, declining, or remaining the same over time?*

Lake enrichment levels for Wisconsin lakes can range from being oligotrophic (i.e., lakes that experience low levels of productivity) to eutrophic (i.e., lakes that are highly productive). A natural aging process occurs in all lakes, causing them to change from oligotrophic to eutrophic over time, and eventually filling in (Figure 7). Human activity can accelerate this aging process. "Cultural eutrophication" is a term coined by ecologists to define human activity impacts on a lake's trophic state.

Although trophic states are labeled for the purposes of discussion, keep in mind that in nature, the categories make smooth transitions into each other. Data from one date may show your lake as being eutrophic, and the next date as being mesotrophic.

If your lake has many rooted aquatic plants and relatively clear water, the TSI could be a mischaracterization of the true nutrient status of your lake. Lakes dominated by aquatic plants tend to have high amounts of phosphorus in the bottom sediments and relatively low amounts phosphorus in the water column. On the other hand, lakes that grow mostly algae have high amounts of phosphorus in the water column. The TSI only measures the portion of nutrients that are found in the water column, as evidenced by the amount of algae. So if most of the nutrients are held in the sediments and the lake is loaded with aquatic plants, the true total nutrient status would not be accurately measured using the TSI.

THE NATURAL AGING OF LAKES

Lakes can be divided into three categories based on trophic state: eutrophic, mesotrophic, and oligotrophic. Eutrophic lakes (very productive or fertile lakes) contain an overabundance of algae and may appear green in color. The water clarity of a eutrophic lake is low, meaning the Secchi disc disappears when submerged only a few feet. A eutrophic lake is not necessarily an unhealthy lake, but often has abundant plant growth or algae. Eutrophic lakes often support large fish populations but can be susceptible to oxygen depletion.

In contrast, a less productive lake is referred to as oligotrophic. In oligotrophic lakes, the Secchi disc may be visible to great depths, indicating high water clarity. Oligotrophic lakes generally contain little algae, fewer plants, and often have low fish densities. Mesotrophic lakes categorize the state between the oligotrophic and eutrophic stages. Mesotrophic lakes often have low dissolved oxygen levels in late summer. The hypolimnion (cold, bottom water) in these lakes limits coldwater fish populations and causes phosphorus cycling from the sediments.

A natural aging process occurs in all lakes, causing them to change from oligotrophic to eutrophic over time, and eventually filling in (Figure 7). However, human activity can accelerate this aging process. The term "**cultural eutrophication**," coined by ecologists, defines the human activity impact on a lake's trophic state.

By examining Secchi data over time, general lake productivity can be estimated. But in order to estimate the trophic state of your lake, you must have enough data collected over several years; particularly in the summer months when algal blooms are most prevalent.

Figure 7. *(Taken from Shaw et al. 2000 "Understanding Lake Data")*

CULTURAL EUTROPHICATION • *Accelerated eutrophication of a lake that occurs as a result of human activities in the watershed. These activities increase nutrient loads in runoff water that drains into lakes.*

LAKE SUMMARY REPORT SAMPLE

Lake Water Quality 2008 Annual Report

Dad Lake
Vilas County
Waterbody Number: 979700

Lake Type: SEEPAGE
DNR Region: NO
GEO Region:NE

Site Name	Store
Dad Lake - Deep Hole	643057

Your perception of the amount of algae at the deep hole.

←Did your secchi disc hit bottom and you could still see it?

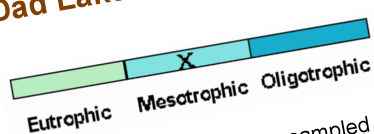
Date	SD (ft)	SD (m)	Hit Bottom				)	TSI (TP)	Lake Level	Clarity	Color	Perception
06/01/2008	11	3.4	NO						LOW	MURKY	BLUE	3-Enjoyment somewhat impaired (algae)
06/17/2008	13	4	NO			40			LOW	CLEAR	BLUE	2-Very minor aesthetic problems
06/25/2008	12.75	3.9	NO			40			LOW	CLEAR	BLUE	1-Beautiful, could not be nicer
07/11/2008	10					44			LOW	CLEAR	BLUE	1-Beautiful, could not be nicer
07/18/2008	12.2					41				CLEAR	BLUE	1-Beautiful, could not be nicer
07/28/2008	12	3.7	NO			41				CLEAR	BLUE	1-Beautiful, could not be nicer
08/04/2008	11.25	3.4	NO			42				CLEAR	BLUE	1-Beautiful, could not be nicer
08/20/2008	13.25	4	NO			40			LOW			not
09/05/2008	12.75	3.9	NO									ot
09/2												ot

←Actual secchi reading in feet.

←Your secchi value converted to trophic state index. Adjusted for Wisconsin.

Sample narrative that will be supplied for each lake.

Dad Lake - Deep Hole 2008 Results



Dad Lake - Deep Hole was sampled **12** different days during the 2008 season. Water clarity was sampled with a secchi disk.

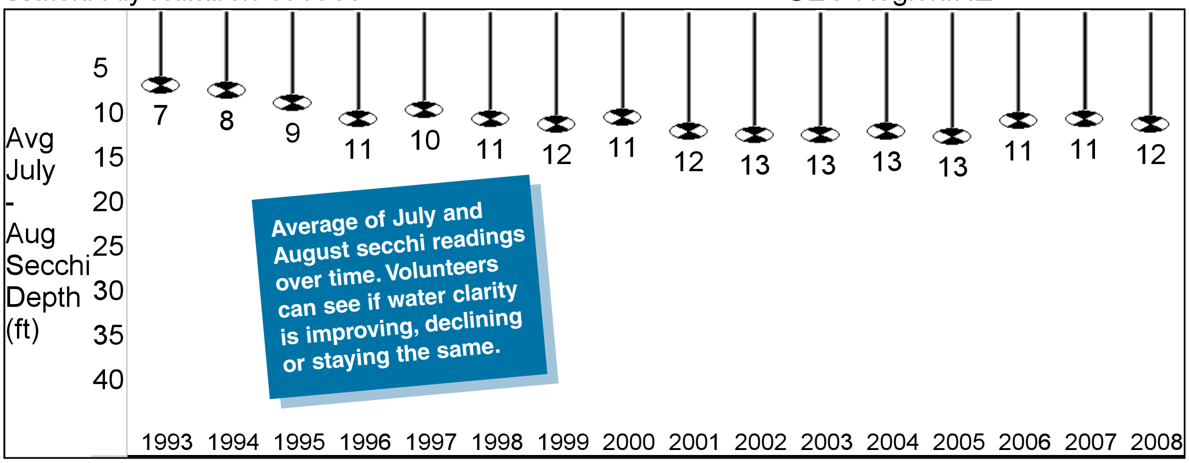
The average summer (July-Aug) secchi disk reading for Dad Lake - Deep Hole (Vilas County, WBIC: 979700) was 11.75 feet. The average for the Northeast Georegion was 10.2 feet. Typically the summer (July-Aug) water was reported as **CLEAR** and **BLUE**.

The overall Trophic State Index (based on secchi) for Dad Lake - Deep Hole was 42. The TSI suggests that Dad Lake - Deep Hole was **mesotrophic**. Mesotrophic lakes are characterized by moderately clear water, but have a increasing chance of low dissolved oxygen in deep water during the summer.

NOTES

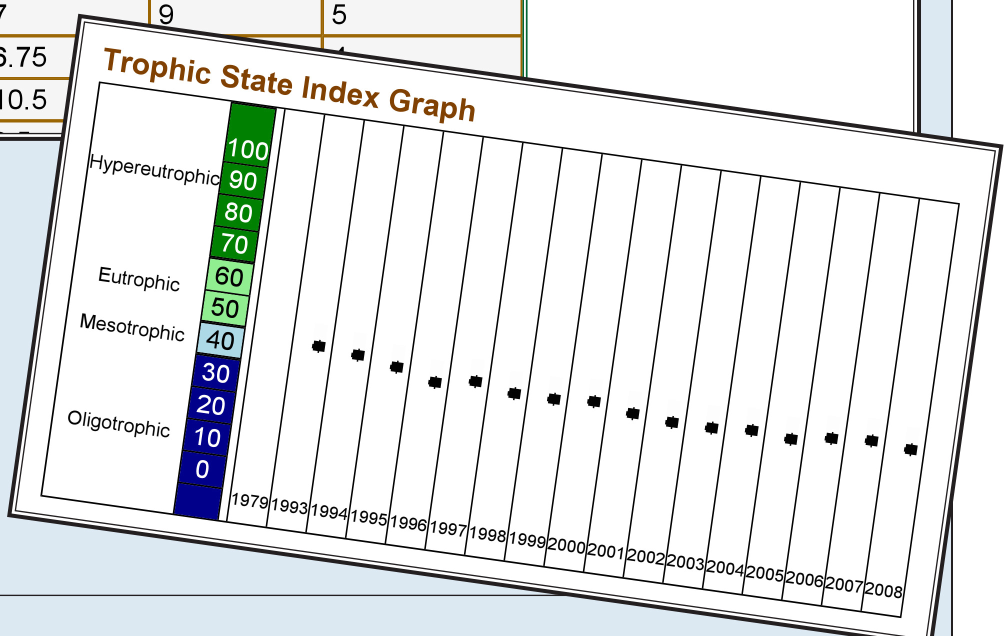
Dad Lake
Vilas County
Waterbody Number: 979700

Lake Type: SEEPAGE
DNR Region: NO
GEO Region:NE



Past secchi averages in feet (July and August only).

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
1993	7.4	6	10	7
1994	8	7	9	5
1995	9.4	6.75		
1996	11.1	10.5		



NOTES

All volunteers are encouraged to report their annual findings at a lake association meeting or publish results in your organization's newsletter. The following is an example of a simple summary that you can follow when generating your own report.

Found Lake 2000 Water Quality Report

This year, Secchi disc readings show that the average water clarity on Found Lake is about 5.25 feet. The deepest clarity reading was 7 feet deep on May 7th. The shallowest clarity reading was 4 feet deep, which happened only a few days earlier on May 3rd. Rainstorms, windy days, or boat traffic can cause the clarity of the lake to fluctuate. This is normal and happens on most lakes. One thing that is important to look for is if the water quality is changing over time. This doesn't seem to be the case for Found Lake. For the last four years the average water clarity readings were 4.75 feet in 1999, 5.0 feet in 1998, 8.3 feet in 1997, and 5.7 feet in 1996.

These historical water clarity readings show that Found Lake is a eutrophic lake. This was verified by the phosphorus and chlorophyll levels in the lake. Although the phosphorus and chlorophyll results from 2000 are not back from the lab yet, the results from 1999 indicate that Found Lake is a eutrophic lake.

A eutrophic lake is a lake that is high in nutrients and supports a large amount of plants and animals. Eutrophic lakes are often weedy and can sometimes have algae blooms. They often support large fish populations, but they are also susceptible to oxygen depletion. 2000 was the first year that oxygen levels were measured on the lake. Oxygen levels were measured once in May and once in August. In Found Lake there was plenty of oxygen for fish to survive in most of the water column, except below 21 feet in May and below 12 feet in August. This oxygen depletion most likely occurs because the plant and algae decomposition during the summer months use up oxygen. The more plants and algae you have, the more that die, and the more oxygen they use up when they decompose. Reducing the amount of nutrients that get into a lake to allow for excessive plant and algae growth will generate less plant matter to decompose and will help keep oxygen levels from getting too low. One way to reduce the amount of nutrients entering the lake is to not fertilizing lawns, reduce erosion, and keep (or restore) a natural shoreline.

Secchi Reading and Light Penetration

Secchi disc measurements can indicate the depth at which your lake contains enough oxygen to support fish and other aquatic life. In general, sunlight can penetrate to a depth 1.7 times greater than your recorded Secchi depth. For example, if your Secchi disc reading is 12 feet deep, that means the sunlight can actually penetrate 20 feet deep (1.7 times 12). The depth at which sunlight can penetrate is called the **photic zone**. It is within this zone that **photosynthesis** occurs and oxygen is produced by algae and other aquatic plants. Plant life is important to provide necessary habitat for fish and invertebrates. In deep, productive lakes, oxygen may become depleted below the photic zone as a result of bacterial **decomposition** of dead plants and animals. Without oxygen, phosphorus and other nutrients may be released from the lake sediments and during the lake's mixing periods be circulated to the surface water. This internal cycling of nutrients can trigger algae blooms, aquatic plant growth, and odor problems.

How Does My Lake Compare to Others?

To examine how your lake quality compares to others around the state, use the summary reports generated by CLMN. These reports contain graphs that chart the Secchi TSIs for each lake type in each georegion. You can find these reports online at **http://dnr.wi.gov/lakes/clmn**.

What if Your Data is Better Than Average

If your Secchi readings are better than average for your lake type and georegion, you will want to work to protect your lake and keep it the way it is. One way to help protect your lake is through a Lake Protection Grant. Qualified lake associations, lake districts, as well as, counties, towns, cities, or villages are eligible to receive lake planning and protection grant funding. Through these 75 percent cost-share grants (75% state share/25% local share), money is available for lake and watershed data collection, development of local lake management plans, land acquisition, and other lake protection activities. For more information on lake grants, contact your CLMN regional coordinator or a UWEX lake specialist. The Wisconsin DNR also has excellent information on lake grants online at **http://dnr.wi.gov/lakes/grants**.

DID YOU KNOW?

Usually, light can penetrate the surface of a lake to about 1.7 times the recorded Secchi depth. This light penetrating zone is called the photic zone. In this zone, plants and algae produce oxygen. Aquatic plants provide good habitat for fish and invertebrates. This zone also provides good habitat for fish and other vertebrates, because the light enables them to see better under water when searching for prey.

PHOTIC ZONE • *The surface and underwater lighted zone in a lake that usually has a depth around 1.7 times the Secchi reading.*

PHOTOSYNTHESIS • *Process by which green plants convert carbon dioxide (CO_2) dissolved in water to sugar and oxygen using sunlight for energy.*

DECOMPOSITION • *The act of breaking down organic matter from a complex form to a simpler form, mainly through the action of fungi and bacteria.*

GET TO THE ROOT OF THE PROBLEM

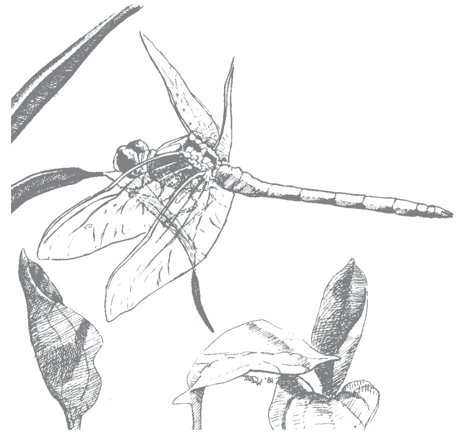
Suppose that your lake is not as clear as others in the area, and that there is some indication of clay turbidity in the spring and after rainstorms. However, the color of your lake is green indicating that algae, not clay, is affecting water clarity. What do you do now?

First, do some detective work.

Your data have given you some clues as to the sources and cycles of nutrients and erosion materials. Drive through the watershed, preferably after a recent rain and observe the condition of the streams entering your lake. Are some more turbid than others? Look upstream and try to track down the sources of turbidity. If you're lucky, you may find some point sources (e.g., pipes) or specific locations such as a field or housing development that is the source of the problem. If you aren't lucky, you may find that there are numerous contributors to stream turbidity. Are there any sewage treatment plants discharging into the river or are houses in the watershed using septic tanks? Sewage in any form is high in nutrients and septic systems sometimes fail or are deliberately by-passed. By the time you have done several of these surveys you might have a better idea of the sources of your lake's problems. It might even be necessary to obtain a detailed map that includes the watershed and start mapping problem streams and sources.

Second, take more Secchi measurements in your lake.

Even though the Network requires you to collect data every other week, you can sample more often if you think it is important. Make a point to sample your lake after rainstorms to see if there is any relationship between rainfall and your lake's turbidity. You may also want to sample more sites on your lake, preferably near the mouths of streams that you think may be causing turbidity. To make these new sites "official" contact your regional coordinator. If you think weekend watercraft use may be affecting your water clarity, try sampling the lake during the week and again on the weekend (Don't forget to make a note of this on your data sheet!). Volunteers have even used their Secchi data to detect the consequences of leaking septic systems by monitoring decreases in transparency near houses. Be sure to write down all of your observations and report your data to the Network. We really do want to know more about your lake, too!



What if Your Data is Worse Than Average

If your Secchi readings are lower than average for your lake type and georegion, the first step is to try to figure out what is causing the low readings. If your water appears clear and brown, chances are your lake is a "stained" lake. This staining is natural and not an indication of a water quality problem. With this kind of lake, you may want to get involved in chemistry monitoring which can give you more information about the trophic status of your lake.

If your water appears murky and brown, the problem may be sediment. In this case, you will want to investigate where the problem is coming from. Sediment in the water can be due to erosion along the lake shore, or erosion coming from streams that flow into lakes. Sediment in your lake could also be a result of carp or boat traffic stirring up the bottom.

Clear and green, or murky and green water may suggest that algae are impacting your Secchi readings. In this case, working with people that live and work around your lake to reduce nutrient inputs is one thing you can do. If your lake is surrounded by farms, farm owners can apply best management practices to reduce the amount of nutrients that flow into your lake. Maintaining a healthy, diverse aquatic plant community will help to reduce shoreland erosion and create habitat for fish and wildlife. Convincing others to plant natural vegetation along their lakeshore is another great way to reduce the amount of nutrients that enter your lake. If your lake is in an urban area, work to convince landowners to use less fertilizer on their lawns. In urban areas, rain gardens are another great way to reduce pollution. Rain gardens are small depressions in your yard, landscaped with native plants and wildflowers. These water-loving plants help capture runoff, allowing more water to infiltrate into your soil, rather than running down the pavement into the storm drain and ultimately your lake.

It is important to keep AIS out of your lake. AIS can have a detrimental impact on the natural balance in the lake ecosystem. Chemical control of EWM or curly-leaf pondweed may increase algae populations.

You may want to apply for a Lake Planning Grant if sediment or algae are having a negative impact on your lake. Your lake association can use the grant to prepare a long-term management plan. For more information on applying for a Lake Planning Grant contact your CLMN regional coordinator or a UWEX lake specialist. The Wisconsin DNR website also provides excellent information on lake grants at **http://dnr.wi.gov/lakes/grants**.

If you do not have a lake association, form one. Lake associations are organizations of individuals who own land on or near a lake. Dealing with the broad range of issues and concerns that face our lakes can be overwhelming for one person. Working as an organized group that shares a common goal can make even the most difficult problems easy. For more information on forming a lake association or other ways to organize, please contact: Lake Specialist, UW-Extension, College of Natural Resources, UW-Stevens Point, Stevens Point, WI 54881-3897. Or, visit **http://www.uwsp.edu/cnr/uwexlakes/associations**.

If you already are part of a lake association, you can share your data by doing a presentation or writing an article for the newsletter.

The best way to help solve your lake's problems is through education. Try planning a lake fair or event. A lake fair is a good way to help lake property owners and users become involved with lake issues. A lake fair is an educational and social event that blends a sense

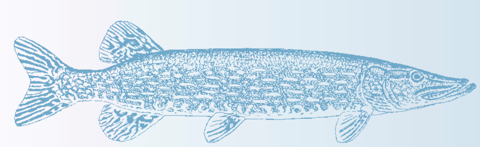
WHERE DOES THE STORM WATER GO?

If you look in the street outside of your home or office and search the parking lots around town, you will probably find storm sewer inlets. Did you ever wonder where they go?

A common misconception about storm sewers is that they go to a waste-water treatment plant. This is not the case. Storm sewers transport stormwater (rain and melting snow) to the nearest river, lake, stream, or wetland. Stormwater often contains materials found on streets and parking lots such as oil, antifreeze, gasoline, soil, litter, pet wastes, fertilizers, pesticides, leaves, and grass clippings. When these materials enter lakes and streams, they become pollutants that kill fish, reduce the aesthetics of the water, and may even close beaches. (UW Extension 1991)

What can I do?
You can:

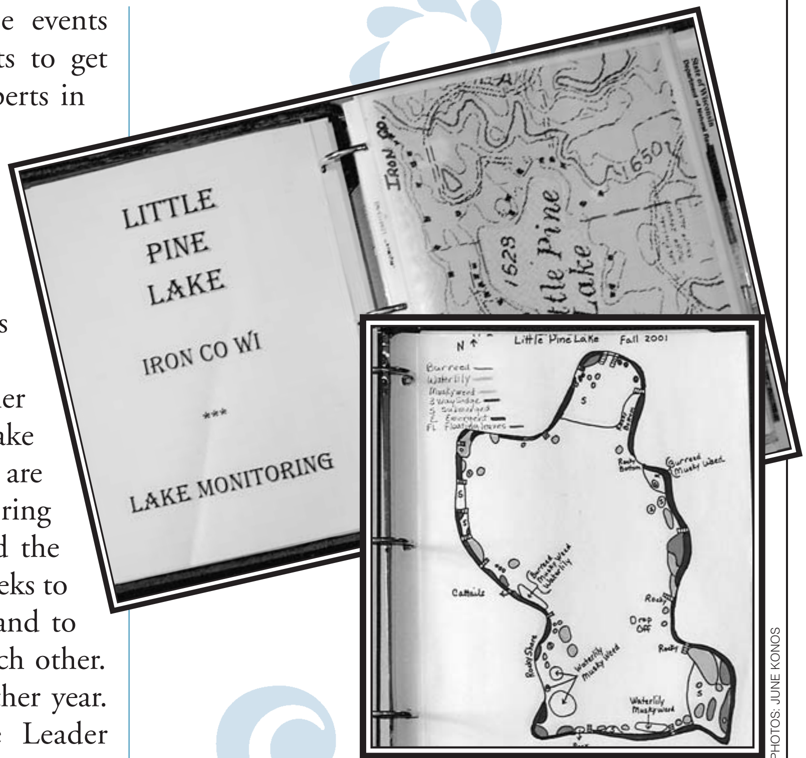
- ☑ plant trees, shrubs or ground covers,
- ☑ maintain a healthy lawn,
- ☑ redirect down spouts from paved areas to vegetated areas,
- ☑ use a rain barrel to catch and store water for gardens,
- ☑ install gravel trenches along driveways or patios,
- ☑ use porous materials such as wooden planks or bricks for walkways and patios,
- ☑ have the driveway and walkways graded so water flows onto lawn areas, and
- ☑ wash your car on the lawn, not the driveway. (UW Extension 1991)



of discovery and entertainment. These events provide an opportunity for participants to get hands-on experience, talk with lake experts in an informal setting, meet lake neighbors, and build relationships. For more information on organizing a lake fair, please contact: Lake Specialist, UW-Extension, College of Natural Resources, UW-Stevens Point, Stevens Point, WI 54881.

Another great opportunity to further your limnology skills is to attend the Lake Leader Institute. The Institute's seminars are designed to stretch the minds by exploring new ideas about lakes management and the human use of lakes. The Institute also seeks to develop networks to share experiences and to encourage participants to learn from each other. The core curriculum is offered every other year. For more information on the Lake Leader Institute, please visit **http://www.uwsp.edu/cnr/uwexlakes/lakeleaders/**.

The Lakes Convention is an annual event that gives educators, lake lovers, federal, state, and local experts a chance to get together and discuss lake issues. Please visit **http://www.uwsp.edu/cnr/uwexlakes/conventions/** for more information on the convention.



PHOTOS: JUNE KONOS

Record-Keeping

Keeping a "Lake Log"

As a CLMN volunteer, you are a record-keeper of your lake's overall health. The Secchi clarity data, water chemistry information, and observations that you supply help with current management activities and also provide a basis for future management. The information that you collect in the field, as well as, the summary results presented in CLMN reports, should be used to create a "lake log" (i.e. a long-term record of your lake's overall history and health).

The field data sheet copies of your water clarity and chemistry information can be used as basic information for starting your lake log. Eventually you can add graphs, news clippings, lake history, maps, wildlife sightings, land use records, etc., to make your log complete. The sky's the limit! But don't take on this responsibility alone. You can share record-keeping responsibilities by enlisting the help of lakeshore residents, lake association members, and youth or school groups to help collect and compile information.

For a *basic* lake log, the following items are recommended: a lake map, copies of your field data sheets and notes, and your annual data summary sheets. In addition to the items listed above, if you would like to compile a more comprehensive lake log the following items are recommended.

- ☑ Graphs of your results
- ☑ General lake ecology information (e.g., CLMN reports, *Understanding Lake Data*, etc.)
- ☑ Statewide CLMN data summary sheets
- ☑ Planning and protection grant information
- ☑ Precipitation and other weather information
- ☑ Ice-on and ice-off dates
- ☑ Wildlife sightings
- ☑ Illustrations and photographs
- ☑ Aquatic plant information
- ☑ Lake history notes from interviews with long-time residents
- ☑ Historical maps showing watershed development
- ☑ Video or photos of shoreline development runoff, plants, algal blooms, etc.
- ☑ Any other data or information collected about your lake

Assembling the Basics

The Wisconsin DNR has maps for many lakes in Wisconsin available online at **http://dnr.wi.gov/maps/**. When you sample, make careful observations. Your initial observations are important since they can help you remember (and others understand) what is happening in and around your lake. In addition, taking careful field notes can provide a better understanding of the water quality and ecosystem conditions on your lake. Always remember to keep copies of your Secchi and field data sheets, the annual data summary sheets for your lake, and the statewide data summaries. The easiest way to do this is to three-hole punch them and add them to your lake log binder. CLMN volunteers receive graphs showing Secchi visibility, water chemistry, and their lake's trophic state index annually.

SECCHI DIP-IN

The Secchi Dip-In is an annual event coordinated by Kent State University, where individuals from all over the world take a Secchi reading sometime between the end of June and the middle of July each year. You should report your data from these dates to the Network, and optionally, you can also report them to the Secchi Dip-In online. For more information on this annual event please visit http://dipin.kent.edu/ or email dipin@kent.edu.

REMOTE SENSING

Since 1999, volunteers have assisted in a collaborative research effort with University of Wisconsin Environmental Remote Sensing Center by taking Secchi readings on dates when the satellites were over their lakes. The volunteers' participation has allowed the University to successfully calibrate computer programs that use satellite imagery to predict Secchi disc depth and other water quality parameters on lakes. The ultimate goal is to put the satellite data into everyday use by making the water clarity data derived from the satellite imagery available to the Wisconsin DNR and to the public. The dates that satellite photos will be taken of your lake are available online at http://dnr.wi.gov/lakes/CLMN/remotesensing/. Take Secchi readings on as many of the dates as you can. If you collect data on "satellite dates," you don't need to do anything special to report it. The Network will automatically include your data in the analysis of the satellite imagery. Just think, on a clear satellite day, your Secchi reading may translate into hundreds of other readings; almost as if you're monitoring hundreds of lakes at one time!

Glossary

Algae. Small aquatic plants containing chlorophyll and without roots that occur as a single cell or multi-celled colonies. Algae form the base of the food chain in an aquatic environment.

Algal bloom. A heavy growth of algae in and on a body of water as a result of high nutrient concentrations.

Aquatic Invasive Species (AIS). Refers to species of plant or animal that are not native to a particular region into which they have moved or invaded. Zebra mussels and Eurasian water-milfoil are examples of AIS. Wisconsin has laws preventing the spread on boats and trailers.

Bathymetric map. A map showing depth contours in a water body. Bottom contours are usually presented as lines of equal depth, in meters or feet. Often called a hydrographic map.

Chlorophyll. Green pigment present in all plant life and necessary for photosynthesis. The amount of chlorophyll present in lake water depends on the amount of algae and is used as a common indicator of water quality.

Cultural eutrophication. Accelerated eutrophication of a lake that occurs as a result of human activities in the watershed. These activities increase nutrient loads in runoff water that drains into lakes.

Decomposition. The act of breaking down organic matter from a complex form to a simpler form, mainly through the action of fungi and bacteria.

Deionized water. Water that has been passed through a column or membrane to remove ions present.

Distilled water. Water that is boiled in a still and the condensate collected and distributed. Distillation removes both ionic and nonionic organic contaminants.

Dissolved oxygen. A measure of the amount of oxygen gas dissolved in water and available for use by microorganisms and fish. Dissolved oxygen is produced by aquatic plants and algae as part of photosynthesis.

Drainage lake. Lakes fed primarily by streams and with outlets into streams or rivers. They are more subject to surface runoff problems but generally have shorter residence times than seepage lakes. Watershed protection is usually needed to manage lake water quality.

Epilimnion. The uppermost circulating layer of warm water that occurs in stratified lakes in summer because of the differences in water density.

Euphotic zone. That part of a water body where light penetration is sufficient to maintain photosynthesis.

Eutrophic. Lakes characterized by high nutrient inputs, high productivity, often experiencing algal blooms and abundant weed growth. This term can also refer to a nutrient-rich lake, as large amounts of algae and weeds characterize a eutrophic lake.

Eutrophication. The process by which lakes and streams are enriched by nutrients causing an increase in plant and algae growth.

Georegion. Wisconsin's lake "georegions" originated from a grouping of lakes made in the early 1980s by Wisconsin DNR senior limnologists. These groupings are based on the best professional judgment of the scientists most familiar with Wisconsin's lake resources. The georegions roughly reflect "hydro-chemical lake regions" which are based on the state's bedrock geology, glacial geology and soil type, and the more recently described "ecoregions" which are based on geological characteristics as well as the dominant vegetation.

Hypolimnion. The cold, deepest layer of a lake that is removed from surface influences.

Lake association. A voluntary organization with a membership generally comprised of those who own land on or near a lake. The goals of lake associations usually include maintaining, protecting, and improving the quality of a lake, its fisheries, and its watershed.

Lake classification. A way of placing lakes into categories with management strategies best suited to the types of lakes found in each category. For example, lakes can be classified to apply varying shoreland development standards. They can be grouped based on hydrology, average depth, surface area, shoreline configuration, as well as, sensitivity to pollutants and recreational use.

Lake district. A special purpose unit of government with the cause of maintaining, protecting, and improving the quality of a lake and its watershed for the mutual good of the members and the lake environment.

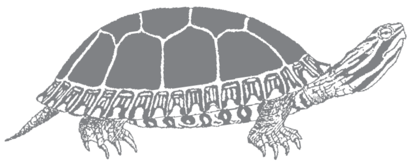
Limnology. The study of inland lakes and waters. The study of the interactions of the biological, chemical, and physical parameters of lakes and rivers.

Macrophyte. Large, rooted or floating aquatic plants that may bear flowers and seeds.

Meniscus. The curved upper surface of a still liquid in a tube caused by surface tension.

Mesotrophic. Lakes characterized by their moderately fertile nutrient levels. Falls in between the oligotrophic and eutrophic levels of nutrient enrichment.

Metalimnion. Sometimes referred to as the thermocline. The narrow transition zone between the epilimnion and the hypolimnion that occurs in stratified lakes.



Nitrogen. One of the major nutrients required for the growth of aquatic plants and algae.

Oligotrophic. Lakes characterized by low nutrient inputs and low productivity. They are generally deep with high water clarity.

Parts per million (ppm). An expression of concentration indicating weight of a substance in a volume of one liter. Milligrams per liter (mg/l) is an equivalent unit.

pH. The measure of the acidity or alkalinity of a solution. Neutral solutions are defined as having a pH of 7.0. Solutions which are known as acidic have a pH lower than 7. Solutions which are known as basic have a pH greater than 7.

Phosphorus. The major nutrient influencing plant and algal growth in more than 80% of Wisconsin lakes. Soluble reactive phosphorus refers to the amount of phosphorus in solution that is available to plants and algae. Total phosphorus refers to the amount of phosphorus in solution (reactive) and in particulate forms (non-reactive.)

Photic zone. The surface and underwater lighted zone in a lake that usually has a depth around 1.7 times the Secchi reading.

Photosynthesis. Process by which green plants convert carbon dioxide (CO_2) dissolved in water to sugar and oxygen using sunlight for energy. Photosynthesis is essential in producing a lake's food base and is an important source of oxygen for many lakes.

Phytoplankton. Very small free-floating aquatic plants, such as one-celled algae. Their abundance, as measured by the amount of chlorophyll a in a water sample, is commonly used to classify the trophic status of a lake.

Qualified Lake Association. To be eligible for state lake planning, protection and recreational boating facilities grants, a lake association must meet certain standards set out in section 281.68 of the Wisconsin statutes.

(Glossary continued on next page)

Respiration. The reverse reaction of photosynthesis. The complex process that occurs in the cells of plants and animals in which nutrient organic molecules, such as glucose, combine with oxygen to produce carbon dioxide, water, and energy. Respiration consumes oxygen and releases carbon dioxide. This process also takes place during decomposition as bacterial respiration increases.

Runoff. Water from rain, snow melt, or irrigation that flows over the ground surface and into streams or lakes.

Secchi disc. A 20-cm (8-inch) diameter disc painted white and black in alternating quadrants. It is used to measure light transparency in lakes.

Seepage lakes. Lakes without a significant inlet or outlet, fed by rainfall and groundwater.

Spring lakes. Lakes that have no inlet, but have an outlet. The primary source of water for spring lakes is groundwater flowing into the bottom of the lake from inside and outside the immediate surface drainage area. Spring lakes are found at the headwaters of many streams and are a fairly common type of lake in northern Wisconsin.

State Laboratory of Hygiene. The state of Wisconsin's public health and environmental laboratory.

Station # (or Storet #). A number assigned to sampling locations on a waterbody. The Station # makes it easy to track secchi and chemistry data. Each sampling site on a lake will have a separate Station #.

Stratification. The layering of water due to differences in temperature and density.

SWIMS. Surface Water Integrated Monitoring System. The database where all CLMN data and other water quality data is stored.

Tannins. Natural pigments found in organic matter such as leaves and bark.

Thermocline. Sometimes referred to as the metalimnion. The narrow transition zone between the epilimnion and the hypolimnion that occurs in stratified lakes.

Trophic state. The extent to which the process of eutrophication has occurred is reflected in a lake's trophic classification or state. The three major trophic states are oligotrophic, mesotrophic, and eutrophic.

Turion. A specialized bud which consists of condensed leaves and stems. This structure is most often an "over-wintering" structure, but in the case of curly-leaf pondweed is an "over-summering" structure. When the appropriate water conditions are reached, the turion will sprout a new plant.

μg/L. micrograms per liter is an expression of concentration indicating weight of a substance in a volume of one liter. Parts per billion (ppb) is an equivalent unit.

Volunteer Identification Number. All data collected in CLMN is tied back to an individual's volunteer id number. Necessary if one wishes to enter data into the database.

Waterbody # or WBIC (Waterbody Identification Code).
A unique identification number the Wisconsin DNR uses to identify each waterbody in the state. Every one of the 15,000 lakes in Wisconsin has a unique WBIC.

Watershed. The area of land draining into a specific stream, river, lake, or other body of water.

Zebra mussel. A tiny bottom dwelling mollusk native to Europe.

Zooplankton. Plankton that is made up of microscopic animals, for example, protozoa, that eat algae. These suspended plankton are an important component of the lake food chain and ecosystem. For many fish and crustaceans, they are the primary source of food.

Appendix 1: Secchi Collection Summary Sheet

1. Contact your Citizen Lake Monitoring Network coordinator for a volunteer identification number, waterbody # or WBIC (Waterbody Identification Code) and Station #. The Station # identifies the sample site on the lake, usually the deepest part of the lake (the deep hole).
2. Before going out to collect Secchi reading, be sure that conditions are right and safe for sampling.
   - Sunny to partly sunny/cloudy skies
   - Wind calm to breezy – there should be no white caps on the lake
   - Between 10:00 am and 4:00 pm
3. Gather your reporting form, lake map with the sample site marked, PFD and Secchi disc. Motor to the deep hole or other designated sampling site. Anchor boat.
4. Mark time and date on your data sheet.
5. Remove sunglasses. Secchi reading is taken from the shady side of the boat.
6. Unwind the Secchi disc rope from the holder. Lean over the shady side of the boat and slowly lower the Secchi disc into the water until you can no longer see it. You should be as close to the surface of the water as is safe. If you are sampling from a pontoon boat, kneel down on the floor of the boat.
7. When the Secchi disc barely disappears from view, mark the rope at the water level with a clothes pin.
8. Lower the Secchi disc a few more feet into the water. Slowly raise the disc. When the Secchi disc reappears, mark the rope at the water level with the second clothespin. The clothespin may be at the same spot or there may be several inches to several feet difference.
9. Bring the Secchi disc back into the boat. Average the two Secchi readings by forming a loop between the two clothespins. Slide one clothespin into the center of the loop to mark it. Remove the other clothespin. The remaining clothespin will be your Secchi reading.
10. Count the number of feet from the disc until you reach your clothespin. Round off to the nearest quarter foot and record that number on your data sheet.
11. Complete water aesthetics survey on your worksheet. Water level should be recorded using the ordinary high water mark as the norm.
12. To determine if the water appearance is clear or murky, hold your Secchi disc **one foot** under the surface of the water and observe how the white part of the disc appears.
13. To determine water color, hold your Secchi disc **one foot** under the surface of the water and observe the water against the white of the disc. Clear water should be recorded as "blue."
14. Indicate your perception of the water quality **at the deep hole**. On a scale of 1 to 5 (1 being the best and 5 being the worst) record your perception of the amount of algae in the water.
15. Record weather and other observations.

Appendix 2: How to Report Data Online

Citizen Lake Monitoring
How to Report Data

To get started, you will need a user id and password

- Go to http://wisconsin.gov. Click on **Get Your Wisconsin User ID**. Get your... Wisconsin User ID
- Click **Self Registration**. Scroll down and hit **Accept**.
- Fill in your information. If you have a problem with it not accepting your mailing address, just leave the whole address blank (there is a bug that causes it to not accept some addresses). Only fields with a * are required. Before hitting Submit, print the page and jot down your password. Save in a safe place.
- Open your email account and look for an email from Wisconsin.gov. Click on the link in the email and log in.
- Now, there is only one more step: **Email us your user id** (jennifer.filbert@wisconsin.gov). Include what counties you are volunteering in. You'll get a reply within a couple of business days saying you're all set up to enter CLMN data.

To enter data

- Go to http://dnr.wi.gov/lakes/clmn-data
- Click on the **Submit Data** tab and click **Add New**
- Select the project from the dropdown. Projects are broken down – one for water quality (including Secchi, etc.) monitoring, one for AIS, etc.
- Then, select the monitoring station and data collectors. If there are additional data collectors not listed, feel free to list them in the comments area.
- Enter the Start date and time (when you started monitoring that day). End date and time are optional.
- Down below, enter your written observations in the comment box (i.e. weather, wildlife)
- Click **Next** and fill in your results.
- When finished, click **Save and Add Another Date**, **Enter Temperature/D.O. profile,** or if you're finished: **Save and Return to List**. If you click **Save and Return to List** (or if you click **View List** from the Submit Data tab), you will see the data you recently entered.

How to Edit Existing Data

You can edit data you've entered during the current season. Here's how:

- Log into SWIMS at http://dnr.wi.gov/lakes/clmn-data
- Click the **Submit Data** tab. Click **View List**. Click the pencil icon for the date your want to edit.
- You can edit comments, etc. on the first page if necessary, and then click **Next**. You can now edit your results. If you hit **Save and Return to List**, your changes will save.

If you need assistance with anything related to reporting your data, feel free to contact Jennifer at jennifer.filbert@wisconsin.gov.

Appendix 3: Forms

Secchi Datasheet

Ice Observation Report - “Ice On”

Ice Observation Report - “Ice Off”

Aquatic Invasives Presence/Absence Report

(see next 4 pages)

PLEASE NOTE: You can find the most current version of the forms online.
http://dnr.wi.gov/lakes/forms

State of Wisconsin
Department of Natural Resources

Wisconsin Citizen Lake Monitoring Network - Secchi

Form 3200-100 (R 2/07)

Information is collected under s. 33.02, Wis. Stats. Personally identifiable information, including names of volunteers, will be broadly distributed in conjunction with lakes data.

Waterbody #	**Storet #** (Use separate form for each site)	Lake Name	County	Year

Toll-free Secchi Line Phone: 1-888-947-3282

Names of each volunteer who sampled on each date	**Date** Use 4 digits, e.g., May 19 is 0519	**Time** Round to nearest hour	**Secchi Depth** Round to nearest quarter of a foot	**Hit Bottom** 1=Yes 2=No	**Lake Level** 1=High; 2=Low; 3=Normal; 4=Gauge	**Lake Level** If gauge, enter numerical level	**Appearance** 1=Clear 2=Murky	**Water Color** 1=Blue; 2=Green; 3=Brown; 4=Red; 5=Yellow	**Percep-tion** 1 - 5	**Date Entered**
Observations:										
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If you call in the data, mail the original (blue) copy in the postage paid envelope (or to Citizen Lake Monitoring Network, WI DNR, PO Box 7921, Madison WI 53703) by November 1.
If you enter the data on the web, keep a copy for your records. There's no need to mail a paper copy. The Citizen Lake Monitoring web site is: dnr.wi.gov/org/water/fhp/lakes/selfhelp/

State of Wisconsin
Department of Natural Resources
Wisconsin Lakes Partnership

Ice Observation Report - "Ice On"

Form 3200-131 (R 02/08)

Personally identifiable information collected on this form will be incorporated into the DNR lakes database. It is not intended to be used for any other purposes, but may be made available to requesters under Wisconsin's Open Records laws, s. 19.32 - 19.39, Wis. Stats.

Primary Data Collector

Name	Phone Number	Email

Additional Data Collector Names

Monitoring Location

Waterbody Name	Township Name	County

Describe your observation point

Describe portion of waterbody you can see from your observation point

Date and Time of Monitoring

Start Date	Start Time

Start Date = Date you observed "ice on".

Monitoring Results

"Ice On" = A lake is considered ice covered when the deepest part of the lake is ice covered.

If you or past observers on your lake have always used another method to judge ice-on and ice-off, please describe the method

Date of First "Ice On" (When lake was first observed to be closed in the fall)

Comments

State of Wisconsin
Department of Natural Resources
Wisconsin Lakes Partnership

Ice Observation Report - "Ice Off"

Form 3200-131 (R 02/08)

Personally identifiable information collected on this form will be incorporated into the DNR lakes database. It is not intended to be used for any other purposes, but may be made available to requesters under Wisconsin's Open Records laws, s. 19.32 - 19.39, Wis. Stats.

Primary Data Collector		
Name	Phone Number	Email
Additional Data Collector Names		

Monitoring Location		
Waterbody Name	Township Name	County
Describe your observation point		
Describe portion of waterbody you can see from your observation point		

Date and Time of Monitoring	
Start Date	Start Time
Start Date = Date you observed "Ice Off"	

Monitoring Results
"Ice Off" = The lake is considered thawed when it is possible to boat from any shore to the deepest part of the lake without encountering ice.
If you or past observers on your lake have always used another method to judge ice-on and ice-off, please describe the method
Date First "Ice Off" (When lake was first observed to be open in the spring)
Ice Duration (Total number of days frozen) [provide only if lake was observed daily]
Comments

State of Wisconsin
Department of Natural Resources
Wisconsin Lakes Partnership

Aquatic Invasives Presence/Absence End of Season Report

Form 3200-133 (03/09)

Personally identifiable information collected on this form will be incorporated into the DNR aquatic invasive species database. It is not intended to be used for any other purposes, but may be made available to requesters under Wisconsin's Open Records laws, s. 19.32 - 19.39, Wis. Stats.

Data Collectors

Primary Data Collector Name	Phone Number	Email

Additional Data Collector Names

Total Paid Hours Spent (# people x # hours each)	Total Volunteer Hours Spent (# people x # hours each)

Monitoring Location

Waterbody Name	Township Name	County	Boat Landing (if you only monitor at a boat landing)

Dates Monitored

Start Date (when you first monitored this season)	End Date (when you last monitored this season)

Did at least some data collectors monitor in... May? June? July? August? (circle all that apply)

Did you monitor…	Did you…
All Beaches and Boat Landings? Frequently Some of the Time Not Often/Never	Walk along the shoreline? Frequently Some of the Time Not Often/Never
Perimeter of whole lake? Frequently Some of the Time Not Often/Never	Observe entire shallow water area (up to 3 feet deep)? Frequently Some of the Time Not Often/Never
Docks or piers? Frequently Some of the Time Not Often/Never	Use rake to extract plant samples? Frequently Some of the Time Not Often/Never
Other: ______________________________	Check underwater solid surfaces (boat hulls, dock legs, rocks)? Frequently Some of the Time Not Often/Never
	Other: ______________________________

Did you find…(even if not a new finding for the lake or stream)

Banded Mystery Snail?	Yes No Did not look for	Hydrilla?	Yes No Did not look for
Chinese Mystery Snail?	Yes No Did not look for	Purple Loosestrife?	Yes No Did not look for
Curly-Leaf Pondweed?	Yes No Did not look for	Rusty Crayfish?	Yes No Did not look for
Eurasian Water Milfoil?	Yes No Did not look for	Spiny Waterfleas?	Yes No Did not look for
Fishhook Waterfleas?	Yes No Did not look for	Zebra Mussels?	Yes No Did not look for
Freshwater Jellyfish?	Yes No Did not look for	Other?: ___________	

If you find an aquatic invasive

If you find an aquatic invasive and it is not listed at http://dnr.wi.gov/lakes/AIS fill out an incident report for the species. Then bring the form, a voucher specimen if possible, and a map showing where you found it to your regional DNR Citizen Lake Monitoring Coordinator as soon as possible (to facilitate control if control is an option).

If you don't find an aquatic invasive

If you submit your data online, that is all you need to do. Otherwise, please mail a copy to your regional DNR Citizen Lake Monitoring Coordinator.

Additional Resources

CLMN Web Site: http://dnr.wi.gov/lakes/CLMN
CBCW Web Site: http://www.uwsp.edu/cnr/uwexlakes/CBCW
UWEX Web Site: http://www.uwsp.edu/cnr/uwexlakes

The following resources and many other limnology related books can be found on the web or at your local or University library. Used text books often can be found at college bookstores for a reduced price.

Understanding Lake Data
This booklet will help you understand how lakes work and what your data means for your lake. The CLMN web site can also provide links to other lake information at **http://dnr.wi.gov/lakes/CLMN/**.

Wisconsin Lakes [PUBL-FM-800 91]
This book published by the Wisconsin DNR lists Wisconsin's lakes, their area, depth, if they have public access, and what fish species they support.

Life on the Edge: Owning Waterfront Property
This book was written by Michael Dresen and Robert Korth and published by the University of Wisconsin in 1995. It is an easy to read guide for waterfront owners and covers topics like septic systems, wells, and shoreline development. Copies are available for $10 from University of Wisconsin Extension Lakes Partnership, College of Natural Resources, University of Wisconsin Stevens Point.

Limnology
This book was written by Charles Goldman and Alexander Horne and published in 1983 by McGraw Hill, Inc, New York. It is a basic college limnology text that covers both lakes and streams.

Limnology
This book was written by Robert G. Wetzel and published in 1983 by Saunders College Publishing, Philadelphia. It is a slightly technical college text which covers many topics in great detail.

Through the Looking Glass...
A Field Guide to Aquatic Plants
This book was written by Susan Borman, Robert Korth and Jo Temte and published in 1997 by the University of Wisconsin. It is available from University of Wisconsin Extension Lakes Partnership, College of Natural Resources, University of Wisconsin Stevens Point.

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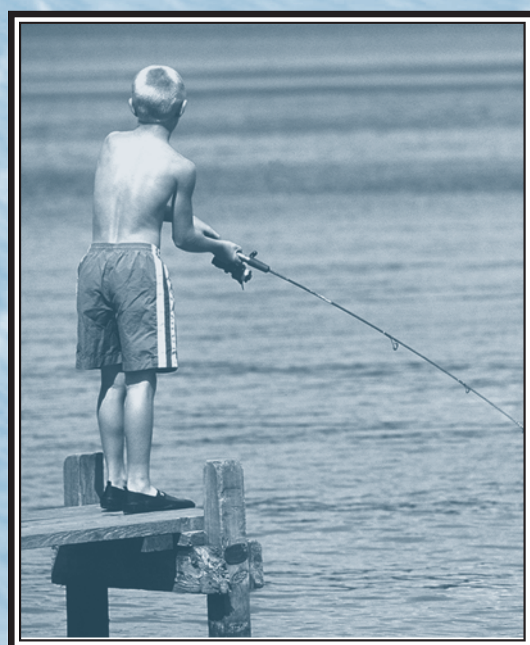

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